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LEVEL II (11)

MICROPROCESSOR CONTROLLED EJECTION SEAT

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The operation of an ejection seat depends on a number of devices on the seat performing certain tasks at specific times. Traditionally, the timing and sequencing of these tasks have been controlled by fuses, gas lines and mechanical linkages, with marginal accuracy and limited logic. This effort was undertaken to demonstrate the feasibility of using a microprocessor to control these functions with increased accuracy and more sophisticated logic. The microprocessor provides timing by electronic clock,

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20. event sequencing via electrical signals, and sophisticated logic based on environmental inputs. In addition, the microprocessor, in conjunction with a gimballed rocket motor, provides the capability of performing a Vertical Seeking Maneuver in the event of an adverse attitude ejection. This report contains the software required to complement all these functions.

S/N 0102-LF-014-6601

FOREWORD

This final report describes the work
accomplished by Computer Sciences Corporation
for the Aircraft and Crew Systems Technology
Directorate of the Naval Air Development
Center, Warminster, Pennsylvania, in accordance
with the requirements defined by Task Order 7,
"Escape System Trajectory Simulation and Micro-
processor Control System" issued under Contract
N62269-78-0191. This work was sponsored by the
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NADC.

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SUMMARY

Computer Sciences Corporation (CSC) Bryn Athyn, Pennsylvania conducted an effort for the Crew Systems Engineering Division (603), Naval Air Development Center. The purpose of this effort was to examine and demonstrate the feasibility of using a microprocessor based system to control the functions of a vertical seeking ejection seat.

In November 1977, CSC issued a report containing the results of an initial study which found the concept to be feasible and recommended further analysis. To this end, NADC initiated the purchase of the IMSAI PCS 80/30 microprocessor based software development system.

In July 1978, CSC issued a second report containing the results of an effort which consisted of the following activities:

1. Define the functional requirements of an ejection seat system.

2. Develop software to demonstrate that the INTEL 8085 microprocessor possesses the capabilities required to perform the desired functions.

3. Examine the reliability and maintainability aspects of the INTEL 8085 to determine whether it meets the requirements defined for military use.

Of these, the primary task was the software development. Although the program had been designed, and much of it coded, complete development was postponed by delays in the shipment of the IMSAI PCS 80/30. In September, CSC completed the development and testing of the program, thus demonstrating the feasibility of the microprocessor controlled ejection seat concept.

The material presented herein assumes that the reader has some familiarity with the IMSAI PCS 80/30 and its operating system (IMDOS).

1.   INTRODUCTION

This document describes the program that was developed and tested to
demonstrate the capability of the INTEL 8085 microprocessor to control
the functions of a vertical seeking ejection seat. The main subroutines
are discussed in some detail, with special emphasis given to the imple-
mentation of the vertical seeking maneuver, the major function in the
ejection sequence. A listing of the program is included, along with
flow diagrams, a definition of each program variable and a map of the
area of memory containing the program data buffers and variables.

The microcomputer system purchased for the development of this program
is the IMSAI PCS 80/30, an integrated I/O terminal based on the INTEL
8085 microprocessor. It includes an intelligent, programmable keyboard
for direct data input, a 5-inch CRT for data output, 3 programmable
memory-mapped timers for real time control and 32K bytes of Random Access
Memory for program loading and execution. A single density dual floppy
disk system provides mass storage.

It should be noted that because of its nature as a software development
system, the IMSAI PCS 80/30 lacks the specialized hardware interfaces and
"peripheral devices" that would be found on a true ejection seat system.
Therefore, although the program was written for implementation on this
system, it would have to be modified slightly before being used in a real
system. The program, however was designed and coded in such a way as to
minimize this transition.

2.   PROGRAM DESCRIPTION

The program consist of two parts. The first is a lengthy initialization
process, most of which is necessitated by the fact that the program is
implemented on a software development system as opposed to a real ejection
seat system. The second controls the timing, sequencing and simulated
execution of the ejection functions. The following discussion describes
each part in detail.

2.1   Initialization

The initialization process is accomplished through a series of CALLs to
the subroutines executing the appropriate initialization functions. Each
of these subroutines, its function, and an explanation is given below.

2.1.1 INZRST75: Initialize Timer Interrupt Handler

Each timer interrupt received causes the execution of the instruction
"RST 7.5", which is essentially a "CALL 003C". Thus, code for handling
the interrupt must begin at memory location 3CH; however, the operating
system under which the program is run (IMDOS) will not load object code
into any memory location below 100H. If code is required in that area
of memory, it must be loaded by the program itself. This subroutine loads
the object code for the instruction "JMP SEQSRT" (the timer interrupt
handling routine) into memory locations 3CH, 3DH, 3EH.

2.1.2 INZTMRS: Initialize System Timers

Because the system timers have no power-on reset, each is programmed to
count to a short termination (.5 µs) and stop. Any timer interrupts that
may be present are cleared.

2.1.3 INZDSP: Initialize Display

The CRT is first initialized by CALLing the INITIALIZATION ENTRY POINT of
the VIO firmware driver. This accomplishes the following:

    1. Clears the screen
    2. Positions the cursor in the upper left corner
    3. Selects an 80x24 screen format
    4. Selects UPPER CASE display mode
    5. Activates screen scroll mode

INZDSP then selects the alternate 40x24 screen format and upper and lower
case display mode.

2.1.4   CHOICE: Initialize Test to be Run

The demonstration program can execute the vertical seeking maneuver from an initial orientation of a 90° roll or a 180° roll. This subroutine displays the message shown in Figure 2.1, then waits for the user to make a selection. Upon receiving a valid input (1 or 2), CHOICE defines the initial orientation of the seat/occupant system, sets up the 'INITIAL ORIENTATION' message to be displayed upon completion of the ejection sequence, and selects the approproate rate data file.

2.1.4.1 Define Initial Orientation of Seat/Occupant System

The program keeps track of the orientation of the seat/occupant system by maintaining the direction cosines of the angles from each of the axes of the seat/occupant coordinate system to the vertical (see Figure 2.2). Within the program, the direction consines are maintained in double precision (16 bit), two's complement form, according to the following scheme:

Value of Direction Cosine	Value in Program
1	4000H
0	0000
-1	C000H

Thus, D31, D32 and D33, (the memory locations in which the three direction cosines are stored) are initialized as follows:

Test selected	$\alpha 31$	D31	$\alpha 32$	D32	$\alpha 33$	D33
1	90	0000	0	4000H	90	0000
2	90	0000	-90	0000H	0	4000H

2.1.4.2 Set Up 'INITIAL ORIENTATION' Message

After completing the execution of the ejection seat functions, the demonstration program displays the initial and final orientation of the seat/occupant system. CHOICE writes the ASCII code for the decimal equivalent of the above initial direction cosines into the message to be displayed.

2.1.4.3 Select Appropriate Rate Data File

For each test, there exists a disk file containing the rate data interpolating points (see Section 2.1.7). CHOICE initializes the File Control Block FCBRD1 to access either file RDATA1.DAT or RDATA2.DAT for test 1 or test 2 respectively.

SELECT DESIRED TEST

1. 90 DEGREE ROLL
2. 180 DEGREE ROLL
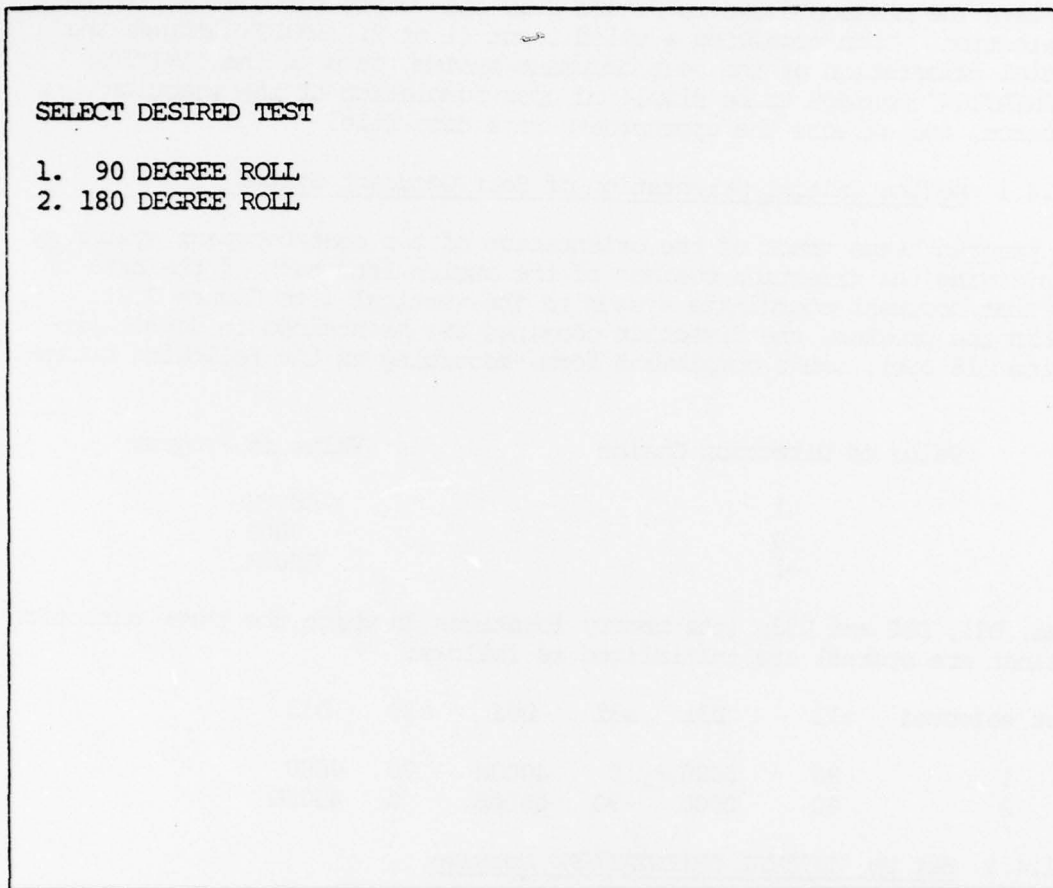
Figure 2.1 CRT Display for Test Initialization
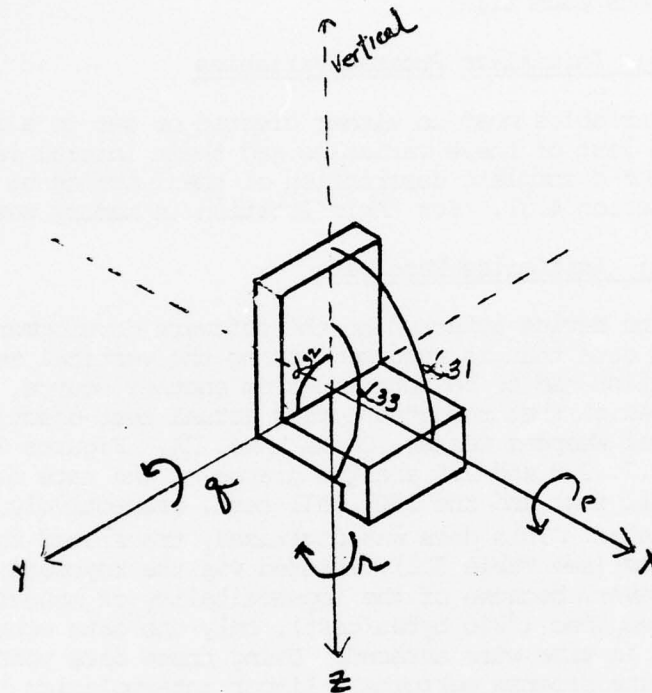
$D31 = $ dir. cos. $\alpha 31$

$D32 = $ dir. cos. $\alpha 32$

$D33 = $ dir. cos. $\alpha 33$

$p = $ rate of rotation around the X-axis (roll rate)

$q = $ rate of rotation around the y-axis (pitch rate)

$r = $ rate of rotation around the z-axis (yaw rate)

Figure 2.2 Seat/Occupant Coordinate System Definition

2.1.5   INZDSK: Initialize Disk

All disk I/O is handled through IMDOS and this requires that a File Control Block (FCB) be set up for each file to be accessed by the program. This subroutine initializes the FCB s for each of four files used by the program. It then opens each file.

2.1.6   INZVRBLS: Initialize Program Variables

Certain program variables must be either cleared or set to a predefined initial value. A list of these variables and their initial value is given in Figure 2.3. For a complete description of the function of each of these variables (see Section 4.3). For their location in memory see Section 4.4.

2.1.7   INZRDATA: Initialize Rate Data

Because there is no device attached to the software development system to generate the rate data that is required during the vertical seeking maneuver, this information had to be obtained from another source. The input data used was based on that recorded during actual test ejections performed at the Naval Weapons Center, China Lake, CA. Figures 2.4, 2.5 and 2.6 and Figures 2.7, 2.8 and 2.9 are the graphs of the rate data recorded during the 90° roll test and the 180° roll test, respectively, of the vertical seeking seat. This data was digitized, translated to the form used in the program (see Table 3.1), entered via the keyboard, and stored on the disk. However, because of the impracticality of manually entering each data point required (7200 bytes/test), only the data corresponding to certain points in time were entered. Using these data points as interpolating points, the program performs a linear interpolation to generate the rest of the data. This data is then stored in memory and read as required during the vertical seeking maneuver.

2.1.7.1 LINT: Linear Interpolation

According to the report in which the test data was issued, microprocessor control is initiated at .389 seconds. Since the rocket motor burns for a nominal 1.5 seconds, the data between T=.389 and T=1.889 was assumed to have been used in the test to perform the vertical seeking maneuver. Accordingly, it is from this portion of each graph that the interpolating points were read. The total elapsed times differ in the demonstration program as indicated on the graphs and defined as follows:

T=.389	=	T=.55 in demo program
T=1.889	=	T=2.05 in demo program

In the vertical seeking algorithm, these times in turn correspond to t=0 and t=1500 (where t= number of ms after the beginning of the maneuver) and are also indicated on the graph. For consistency with the discussion of the vertical seeking algorithm (see Section 3) it is these times that are used below.

VARIABLE	INITIAL VALUE
DCCT	00
PCINC	00
PICHR	0000
PSUM1-2	0000
PSUM1	0000
PSUM2-2	0000
PSUM2	0000
QPOS	0CC0H
QNEG	F340H
RLINC	00
ROLLR	0000
RSUM1-2	0000
RSUM1	0000
RSUM2-2	0000
RSUM2	0000
SCPTR	3800H
SEQINDX	00
TLMPTR	3CB0H
TOGGL	00
VSPTR	4AE0H
YAINC	00
YAWR	0000
YSUM1-2	0000
YSUM1	0000
YSUM2-2	0000
YSUM2	0000

Figure 2.3 Initial Values of Program Variables

STEERABLE SEAT EJECTION TEST OF 2/15/78, ZERO TIME IS 20:16:22.936

R BODY RATE — CHANNEL 53

Demonstration Program Time   .5   2.05

Corresponding VS Time (MS)   0   1500
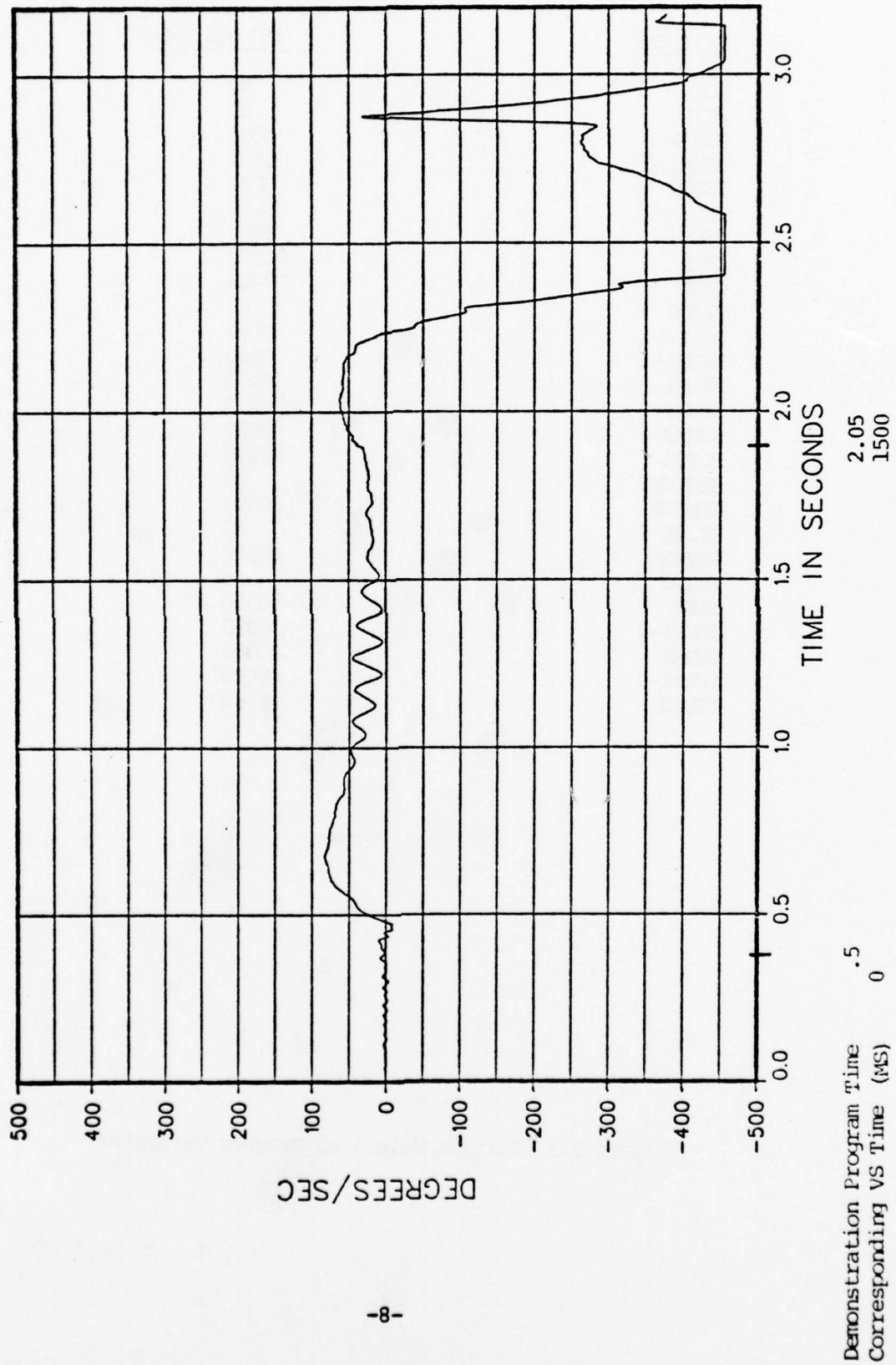
Figure 2.4   R Body Rate Graph – 90° Roll Test

STEERABLE SEAT EJECTION TEST OF 2/15/78. ZERO TIME IS 20:16:22.936

Q BODY RATE — CHANNEL 52
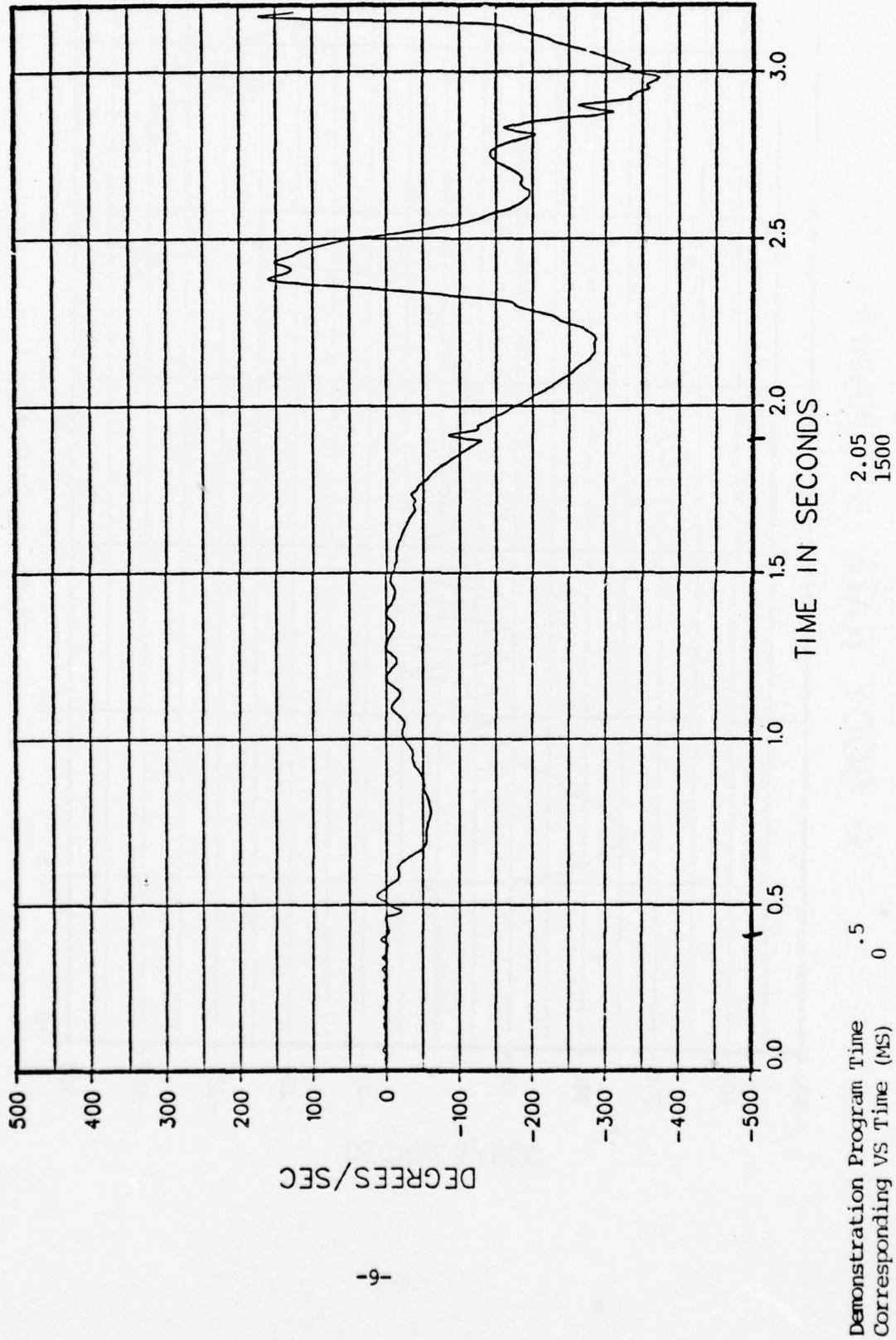
Figure 2.5 Q Body Rate Graph – 90° Roll Test

Demonstration Program Time   .5   2.05
Corresponding VS Time (MS)   0   1500

STEERABLE SEAT EJECTION TEST OF 2/15/78, ZERO TIME IS 20:16:22.936

P BODY RATE – CHANNEL 51
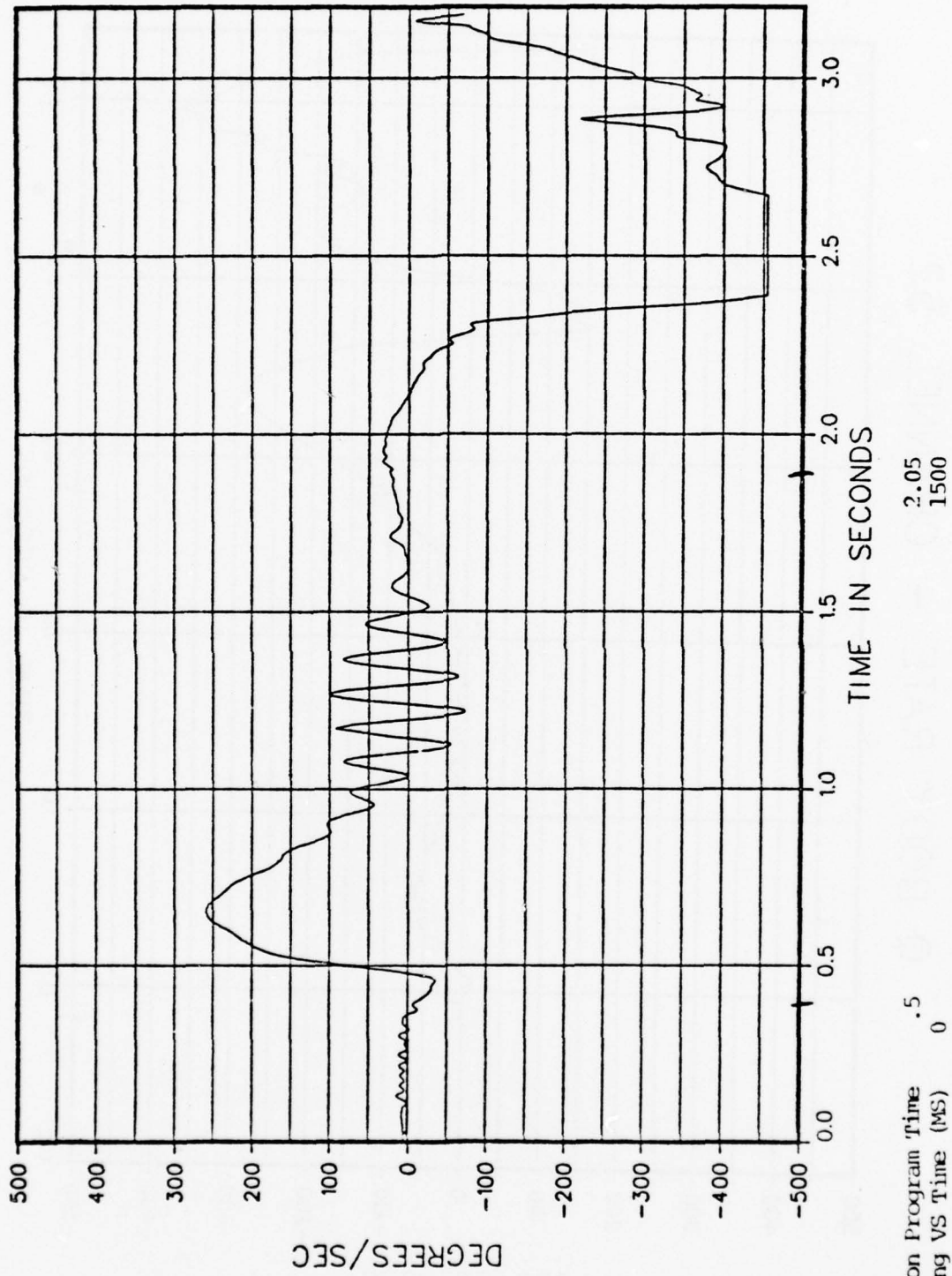
Figure 2.6 P Body Rate Graph – 90° Roll Test

VERTICAL SEEKING SEAT FIRED 6/14/78, ZERO TIME IS 18:21:45.518

.R BODY RATE — CHANNEL 53

Demonstration Program Time   .5   2.05
Corresponding VS Time (MS)   0   1500
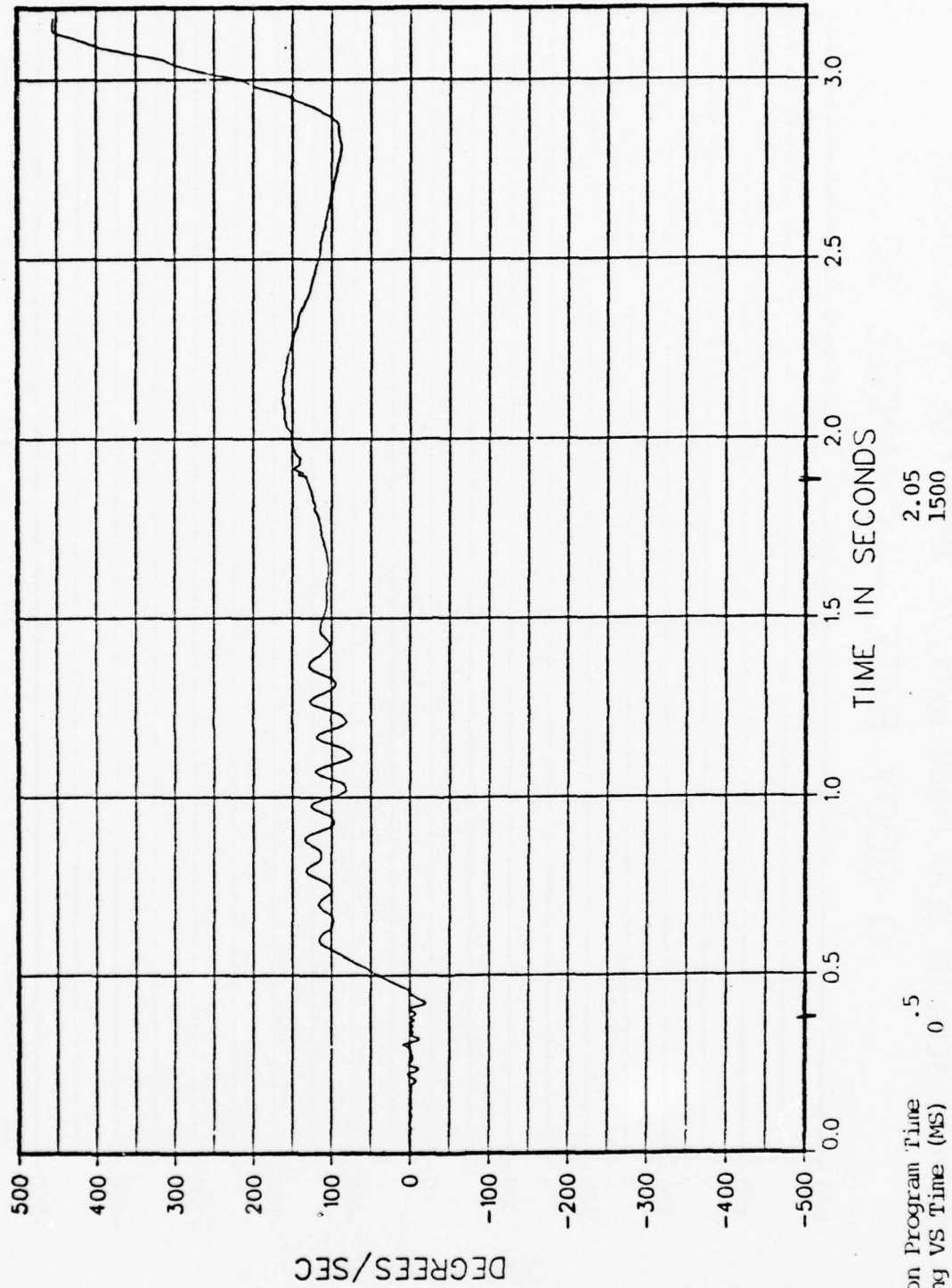
Figure 2.7   R Body Rate Graph – 180° Roll Test

VERTICAL SEEKING SEAT FIRED 6/14/78, ZERO TIME IS 18:21:45.518

Q BODY RATE — CHANNEL 52

| Demonstration Program Time | .5 | 2.05 |
| Corresponding VS Time (MS) | 0 | 1500 |
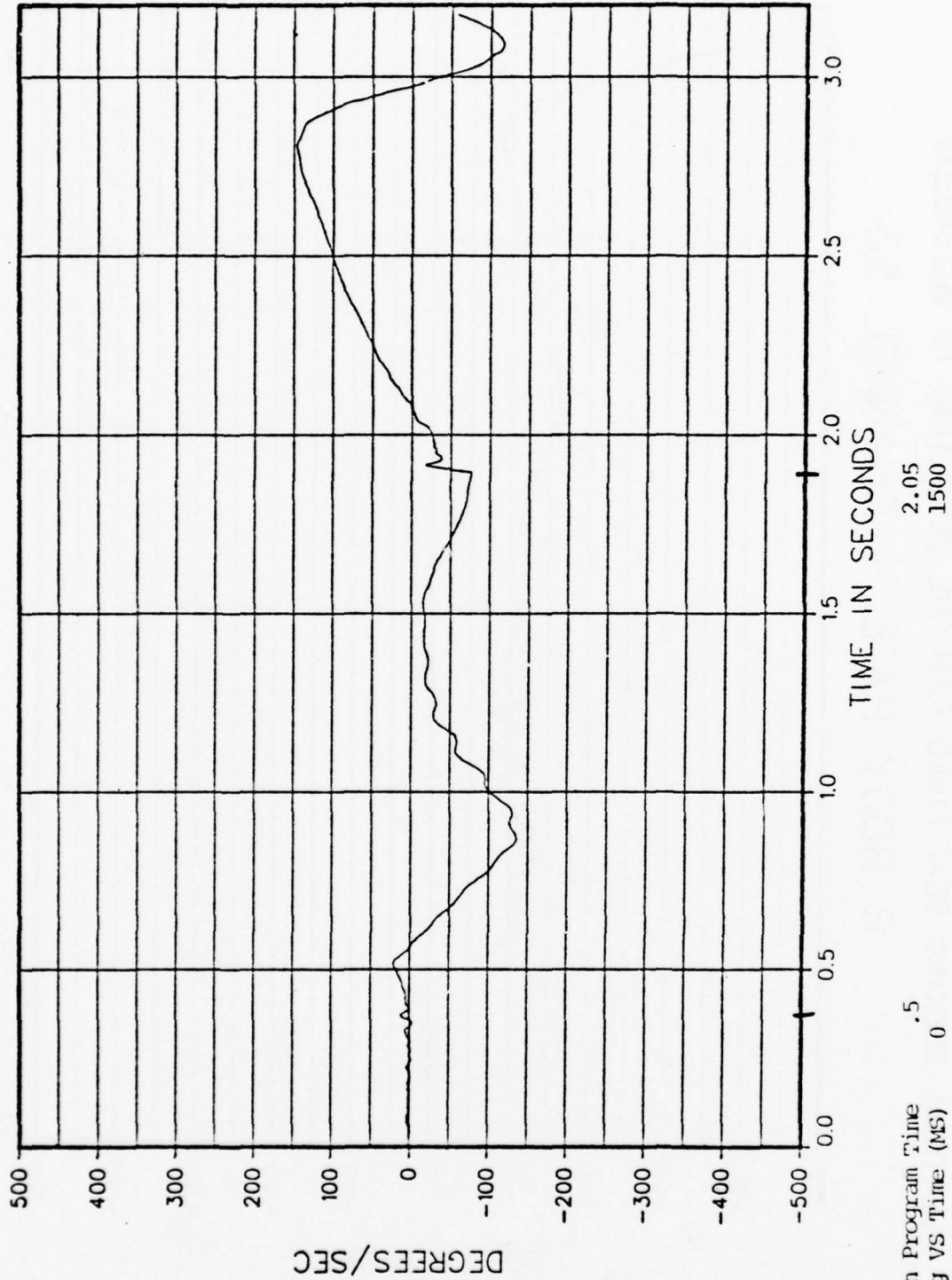
Figure 2.8 Q Body Rate Graph – 180° Roll Test

VERTICAL SEEKING SEAT FIRED 6/14/78, ZERO TIME IS 18:21:45.518

P BODY RATE — CHANNEL 51
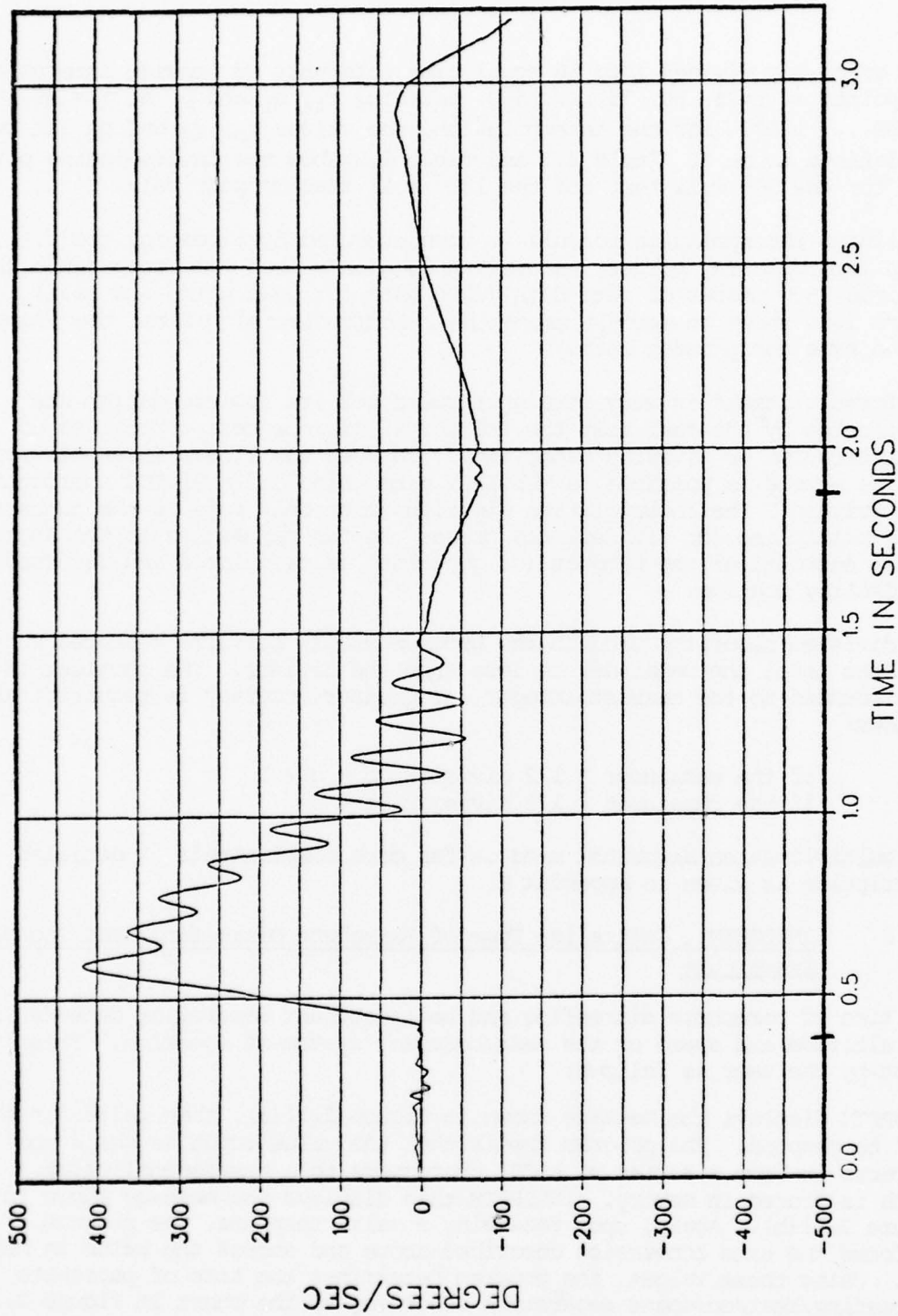
Figure 2.9 P Body Rate Graph – 180° Roll Test

Demonstration Program Time   .5   2.05
Corresponding VS Time (MS)   0   1500

Each graph was divided into 60 equal time intervals to provide interpolating points at t=25, 50, 75,...,1500, defining r_i, q_i and p_i at i = 20, 40, 60, 80..., 1200. For the interpolation, the values r_o, q_o and p_o (at t=0) are defined to be 0. Table 2.1 and Table 2.2 show the interpolating points used for the 90° roll test and the 180° roll test respectively.

The linear interpolation formula is then executed 60 times for the r, q, and p interpolating points, generating 20 points each time to produce the required 3600 pieces of rate data (1200 each for yaw, pitch and roll). Figure 2.10 shows an example using the r interpolating points; the process is the same for p and q data.

The formula itself is very straightforward but its implementation was complicated by the fact that the INTEL 8085 microprocessor provides no multiplication or division capability. To keep the linear interpolation code as simple as possible, a MULTIPLY subroutine and a DIVIDE subroutine were written. The interpolation algorithm then only sets up the numbers to be multiplied (or divided) and passes then as parameters to the appropriate subroutine; the product (or quotient) is calculated and returned to the CALLing routine.

The division algorithm used in the program simply performs repeated subroutines until the remainder is less than the divisor. The quotient is then rounded to the nearest integer (no greater accuracy is required) as follows:

if the remainder $\geq$ 1/2 divisior, q = q + 1
if the remainder $\leq$ 1/2 divisior, q = q

The multiplication algorithm used is far more complicated. A detailed description is given in Appendix B.

2.1.8   INZDRFTM: Initialize Time of Parachute Disreefing/Seat/Occupant Separation

The time of parachute disreefing and seat/occupant separation depends upon the altitude and speed of the seat/occupant system at ejection. These are input by the user as follows:

INZDRFTM displays the message shown in Figure 2.11(a), then waits for the user to respond. The program checks that the value input is valid and converts it from a series of ASCII characters to a hexadecimal value, which is stored in memory. INZDRFTM then displays the message shown in Figure 2.11(b). Again, upon receiving a valid response, the program performs the same conversion described above and stores the value in memory. Using these values, the program determines the time of parachute disreefing/seat/occupant separation according to the chart in Figure 2.12, as defined by NADC personnel.

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INTERPOLATING POINTS FOR 90° ROLL TEST

i	R(i) Deg/Sec	R(i) Hex Equiv	Q(i) Deg/Sec	Q(i) Hex Equiv	P(i) Deg/Sec	P(i) Hex Equiv
0	0	0000	0	0000	0	0000
20	9	0024	2	0008	-14	FFC7
40	4	0010	-5	FFEC	-25	FF9A
60	-2	FFF8	-14	FFC7	-17	FFBB
80	14	0039	-15	FFC3	51	00D1
100	36	0093	4	0010	131	0218
120	46	00BC	8	0020	186	02F9
140	57	00E9	-8	FFE0	209	0357
160	70	011E	-18	FFB7	226	039D
180	73	012A	-18	FFB7	246	03EF
200	78	013F	-30	FF86	255	0414
220	81	014B	-44	FF4C	254	0410
240	82	014F	-53	FF28	242	03DE
260	79	0143	-54	FF23	230	03AD
280	78	013F	-56	FF1B	210	035C
300	74	012E	-58	FF13	183	02ED
320	73	012A	-58	FF13	166	02A7
340	69	011A	-55	FF1F	153	0272
360	67	0112	-52	FF2C	132	021C
380	60	00F5	-50	FF34	109	016E
400	60	00F5	-49	FF38	103	01A5
420	56	00E5	-40	FF5D	96	0189
440	50	00CC	-34	FF75	66	010E
460	44	00B4	-32	FF7D	50	00CC
480	46	00BC	-27	FF92	68	0116
500	40	00A3	-22	FFA6	41	00A7
520	32	0083	-23	FFA2	9	0024
540	38	009B	-18	FFB7	62	00FD
560	42	00AB	-11	FFD3	40	00A3
580	25	0066	-12	FFCF	-25	FF9A
600	22	005A	-19	FFB3	-9	FFDC
620	37	0097	-8	FFE0	62	00FD
640	32	0083	-1	FFFC	26	006A
660	13	0035	-7	FFE4	-52	FF2C
680	22	005A	-10	FFD8	0	0000
700	40	00A3	-4	FFF0	82	014F
720	30	007A	-2	FFF8	30	007A
740	12	0031	-5	FFEC	-44	FF4C
760	22	005A	-8	FFE0	4	0010
780	36	0093	-2	FFF8	68	0116
800	27	006E	-1	FFFC	21	0055
820	11	002D	-6	FFE8	-35	FF71
840	17	0045	-11	FFD3	3	000C
860	28	0072	-7	FFE4	47	00C0
880	21	0055	-6	FFE8	11	002D
900	11	002D	-9	FFDC	-19	FFB3

TABLE 2.1

INTERPOLATING POINTS FOR 90° ROLL TEST

i	R(i)		Q(i)		P(i)	
	Deg/Sec	Hex Equiv	Deg/Sec	Hex Equiv	Deg/Sec	Hex Equiv
920	18	0049	-12	FFCF	~2	FFF8
940	24	0062	-11	FFD3	14	0039
960	24	0062	-16	FFBF	15	003D
980	21	0055	-21	FFAB	4	0010
1000	21	0055	-27	FF92	3	000C
1020	20	0051	-32	FF7D	5	0014
1040	24	0062	-38	FF65	10	0028
1060	25	0066	-37	FF69	22	005A
1080	21	0055	-33	FF79	18	0049
1100	23	005E	-43	FF50	11	002D
1120	27	006E	-54	FF23	17	0045
1140	28	0072	-72	FEDA	18	0049
1160	30	007A	-89	FE94	20	0051
1180	30	007A	-103	FE5B	22	005A
1200	32	0083	-118	FE1D	24	0062

TABLE 2.1 (Continued)

INTERPOLATING POINTS FOR 180° ROLL TEST

	R(i)		Q(i)		P(i)	
i	Deg/Sec	Hex Equiv	Deg/Sec	Hex Equiv	Deg/Sec	Hex Equiv
0	0	0000	0	0000	0	0000
20	-7	FFE4	4	0010	2	0008
40	-7	FFE4	8	0020	30	007A
60	12	0031	11	002D	91	0174
80	32	0083	15	003D	153	0272
100	52	00D4	18	0049	217	0378
120	72	0126	9	0024	298	04C8
140	92	0178	-2	FFF8	364	05D2
160	112	01CA	-12	FFCF	417	06AB
180	108	01BA	-22	FFA6	378	060B
200	101	019D	-33	FF79	338	0567
220	100	0199	-44	FF4C	342	0578
240	110	01C2	-56	FF1B	355	05AD
260	108	01BA	-66	FEF2	318	0515
280	100	0199	-81	FEB5	281	047E
300	109	01BE	-97	FE73	309	04F1
320	132	021C	-108	FE46	306	04E4
340	117	01DE	-115	FE2A	257	041C
360	112	01CA	-126	FDFC	236	03C2
380	123	01F7	-135	FDD8	259	0424
400	122	01F3	-132	FDE3	215	0370
420	103	01A5	-130	FDEC	152	026E
440	99	0195	-130	FDEC	138	0234
460	116	01DA	-118	FE1D	174	02C8
480	110	01C2	-107	FE4F	112	01CA
500	87	0164	-96	FE77	40	00A3
520	94	0180	-96	FE77	78	013F
540	114	01D2	-84	FEA9	114	01D2
560	100	0199	-69	FEE6	41	00A7
580	78	013F	-59	FF0F	-15	FFC3
600	87	0164	-60	FF0B	30	007A
620	110	01C2	-52	FF2C	71	0122
640	100	0199	-39	FF61	12	002D
660	85	015B	-31	FF82	-44	FF4C
680	104	01A9	-31	FF82	1	0004
700	121	01EF	-28	FF8E	42	00AB
720	110	01C2	-22	FFA2	-6	FFE8
740	97	018D	-22	FFA2	-46	FF44
760	111	01C6	-22	FFA2	-5	FFEC
780	125	01FF	-22	FFA2	27	006E
800	122	01F3	-19	FFB3	5	0014
820	108	01BA	-18	FFB7	-22	FFA6
840	105	01AD	-18	FFB7	-18	FFB7
860	111	01C6	-18	FFB7	-4	FFF0
880	109	01BE	-16	FFBF	-2	FFF8
900	106	01B1	-15	FFC3	-6	FFE8

TABLE 2.2

INTERPOLATING POINTS FOR 180° ROLL TEST

	R(i)		Q(i)		P(i)	
i	Deg/Sec	Hex Equiv	Deg/Sec	Hex Equiv	Deg/Sec	Hex Equiv
920	103	01A5	-17	FFBB	-10	FFD8
940	104	01A9	-21	FFAB	-12	FFCE
960	104	01A9	-25	FF9A	-14	FFC7
980	103	01A5	-29	FF8A	-16	FFBF
1000	101	019D	-34	FF75	-18	FFB7
1020	104	01A9	-39	FF61	-22	FFA6
1040	106	01B1	-45	FF48	-27	FF92
1060	109	01BE	-53	FF28	-32	FF7D
1080	112	01CA	-58	FF13	-37	FF68
1100	115	01D6	-63	FEFF	-42	FF55
1120	118	01E3	-68	FEEA	-48	FF36
1140	120	01EB	-70	FEE2	-54	FF23
1160	123	01F7	-73	FED6	-59	FF0F
1180	126	0203	-75	FECD	-64	FEFA
1200	131	0218	-78	FEC5	-69	FEE6

TABLE 2.2 (Continued)

The Linear Interpolation Formula is

$$f(x_i) = \frac{(f_o x_1 - f_1 x_o) + ((f_1 - f_o)(x_i))}{(x_1 - x_o)}$$

where f_o, f_1, x_o, x_1, x_i are defined at each of the 60 passes as follows:

Pass	f_o	f_1	x_o	x_1	$x_i = i$	Points Generated
1	r_o	r_{20}	0	20	1 – 20	$r_1 - r_{20}$
2	r_{20}	r_{40}	20	40	21 – 40	$r_{21} - r_{40}$
3	r_{40}	r_{60}	40	60	41 – 60	$r_{40} - r_{60}$
$\vdots$						$\vdots$
60	r_{1180}	r_{1200}	1180	1200	1181 – 1200	$r_{1181} - r_{1200}$

Figure 2.10 Linear Interpolation

```
SELECT DESIRED TEST

1. 90   DEGREE ROLL
2. 180  DEGREE ROLL


ENTER ALTITUDE AT EJECTION (0-18,000 FT)
```

(a)

```
SELECT DESIRED TEST

1. 90   DEGREE ROLL
2. 180 DEGREE ROLL

ENTER ALTITUDE AT EJECTION (0-18,000 FT)

ENTER SPEED AT EJECTION (0-600 KEAS)
```

(b)

Figure 2.11 Altitude/Speed Initialization Display
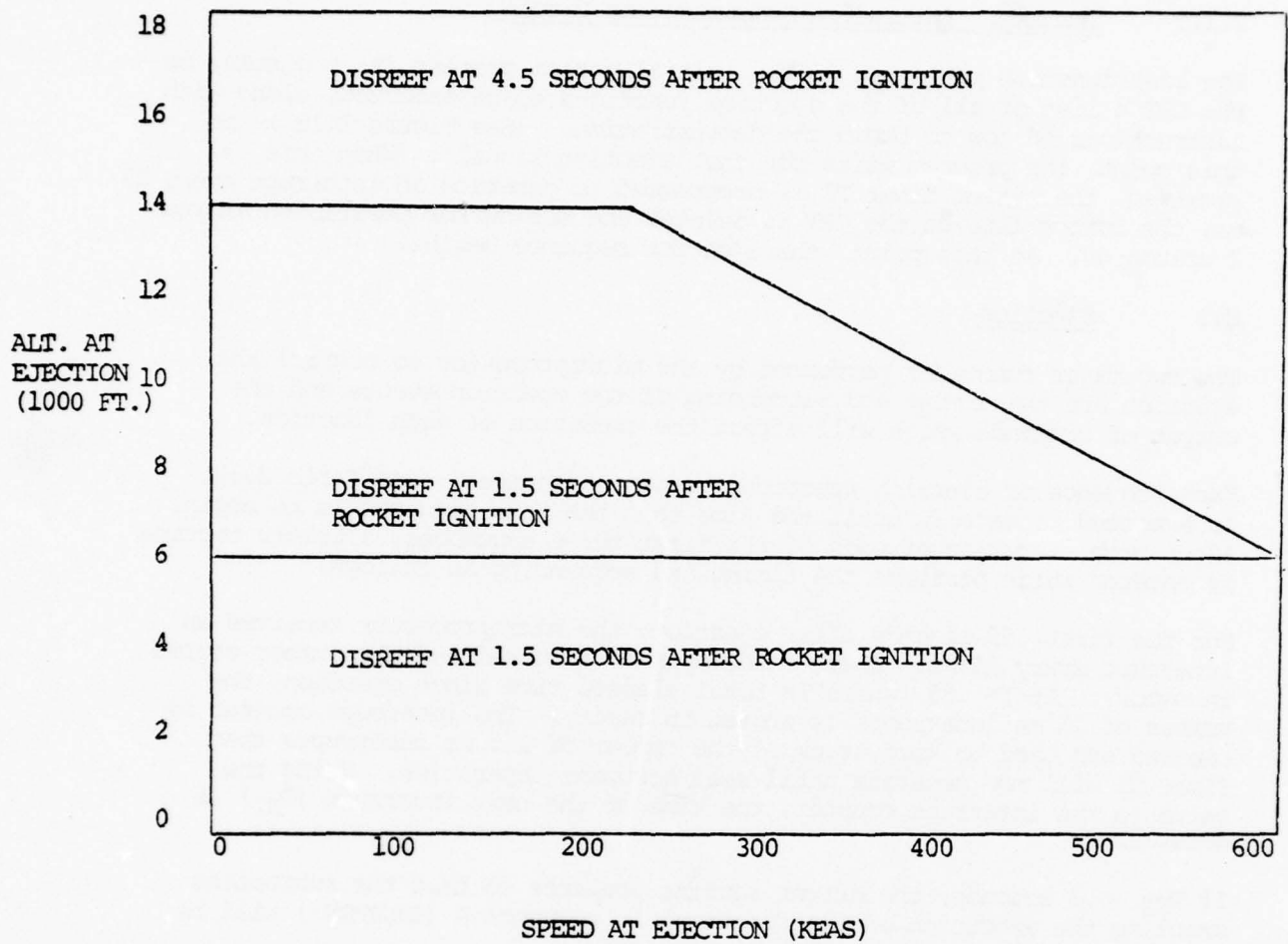
Figure 2.12 Parachute Deployment Chart

2.1.9 INZDEMO: Initialize Demonstration Display

The last function performed in the initialization process is to display on the CRT a list of all of the ejection functions to be executed, along with instructions on how to begin the demonstration. (See Figure 2.13.) At this point, the program waits for the 'ejection signal'. When this is received, the system timer Tl is programmed to generate an interrupt every 25 ms, the bottom line on the CRT is deleted and the cursor positioned at row 2 column 40. At this point, the ejection sequence begins.

2.2 Ejection

The two major functions performed by the microprocessor to control the ejection are the timing and sequencing of the ejection events and the output of commands which will effect the execution of each function.

Each sequence of ejection functions, except sequence D (see Table 2.3), is executed repeatedly until the time that the next sequence is to begin. After each execution of each of the first three sequences, a driver routine is entered which performs the timing and sequencing as follows:

For the first .55 seconds after ejection, the microprocessor receives an interrupt every 25 ms. These interrupts are counted and the number stored in memory. At T= .55 (where T= total elapsed time since ejection) the number of 25 ms interrupts is stored in memory. The interrupt counter is cleared and used to keep track of the number of 2.5 ms interrupts that Timer Tl will now generate until seat/occupant separation. Using the value in the interrupt counter, the time of the next interrupt (T_{NI}) is determined.

If T_{NI} < .3 seconds, the driver routine prepares so that the subroutine enabling the execution of the functions in sequence A (EJCTRTN:) will be indexed when the next interrupt is received.

If .3 seconds $\leq T_{NI}$ < .55 seconds, the driver routine prepares so that the subroutine enabling the execution of the functions in sequence B (CTPLTRTN:) will be indexed when the next interrupt is received.

If T_{NI} = .55 seconds, the driver routine programs the timer Tl to generate an interrupt every 2.5 ms after the next (and last 25 ms) interrupt is received and sets up so that the subroutine enabling the execution of the functions in sequence C (RKTSEQ:) will be indexed upon receiving that interrupt. Since the only function in sequence C to be executed at this time is to ignite the rocket, (this is the only time this function is executed), the driver routine also sets a flag, indicating this to RKTSEQ. If .55 seconds $\leq T_{NI} \leq$ 2.05 seconds, RKTSEQ is indexed. At T= 2.05, sequence C is executed for the last time and control is passed immediately to the suroutine controlling sequence D (PARSEP:). If the time of parachute disreefing/seat/occupant separation is T= 2.05 seconds, these two functions

```
uP EJECTION SEAT FEASIBILITY DEMO

Emergency 02 Generation
Inertial Reel Firing
Neck Bladder Inflation
Hip Thruster Firing
Canopy Removal
Gyro Spinup
Seat Release
Catapult Initiation
Rocket Initiation
Rocket Gimballing Initiated
PCEM Fired
Rocket Gimballing Completed
Parachute Disreefed
Seat/Occupant Separated
*************************************

TO BEGIN DEMONSTRATION, PRESS 'E'
```

Figure 2.13 Feasibility Demonstration Display

TIMING/SEQUENCING OF EJECTION SEAT FUNCTIONS

Sequence	Function	Time Initiated
A - Ejection Sequence		
	1. Emergency O_2 Generation	t_0
	2. Inertial Reel Firing	
	3. Neck Blader Inflation	
	4. Hip Thruster Firing	
	5. Canopy Removal	
	6. Gyro Spin-Up	
B - Catapult Sequence		
	1. Seat Release	$t_0 + .3$
	2. Catapult Initiation	
C - Rocket Sequence		
	1. Rocket Initiation	$t_0 + .55$
	2. Rocket Motor Gimballing	
	3. PCEM Firing	$t_0 + 1.85$
D - Descent Sequence		
	1. Parachute Disreefing	$t_0 + 2.05/t_0 + 5.05$
	2. Seat/Occupant Separation	

Table 2.3 Timing/Sequencing of Ejection Seat Functions

are executed and the ejection is complete. Otherwise, as each 2.5 ms interrupt is received and counted, control is passed directly to PARSEP which waits until T= 5.05 seconds to execute the final sequence to complete the ejection.

To effect the execution of each of the ejection functions on an actual ejection seat system, the microprocessor would output a command word to a specific port. This port would interface with specially designed hardware that would convert the digital data to an analog signal which in turn would enable the desired event. This process is simulated in the demonstration program (subroutine SQUIB:) as follows:

The microprocessor outputs the three character ASCII sequence 00001000_2 (backspace), 00001010_2 (line feed), 00101010_2 (*) to the CRT. This causes the '*' character to be displayed next to the function being extracted indicating its successful completion.

3. THE VERTICAL SEEKING MANEUVER

The implementation of the vertical seeking maneuver, the most critical of the ejection seat functions to be controlled by the microprocessor, is based to a great extent on the work done previously by personnel at the Naval Weapons Center, China Lake, CA. The following discussion describes the vertical seeking seat program as designed, coded and tested at NWC, and indicates where modifications had to be made for implementation in the demonstration program.

Simply stated, the purpose of the vertical seeking maneuver is to insure that the seat/occupant system is in an upright position and traveling in a vertical direction. The microprocessor accomplishes this by properly gimballing the rocket motor according to information describing the initial orientation of the seat/occupant system and by continuously monitoring the angular rates of the system about all three axes. For testing purposes, the initial orientation of the seat/occupant system is predetermined and essentially hardwired in the memory of the microprocessor by storing the direction cosine of the angle of each of the axes of the seat/occupant coordinate system to the vertical. These are updated continuously throughout the maneuver using the rotational rates, and the direction cosines are then used to calculate the rocket gimballing commands. Gimballing the rocket modifies the orientation of the system and the rotational rates, which in turn cause the microprocessor to modify the direction cosines and, ultimately, the rocket gimballing. By this circular process, the system is stabilized as it approaches the desired orientation.

3.1 The Vertical Seeking Algorithm

There are five basic steps comprising the vertical seeking algorithm:

1. Input Rate Data
2. Integrate Rate Data
3. Update Direction Cosines
4. Calculate Rocket Gimballing Commands
5. Output Rocket Gimballing Commands

3.1.1 Input Rate Data

Attached to the ejection seat are gyroscopes which sense the rate of rotation of the seat/occupant around the yaw, pitch and roll axes of the seat/occupant coordinate system. A voltage level proportional to the rotational rate is sent from the gyroscope to an A/D converter which outputs complementary twos complement (CTC) digital data to the microprocessor. This data is then converted to obtain the twos complement form used in the program. Three examples of this conversion process for a typical system are shown in Table 3.1. As presently implemented, rate data is sampled every 1.25 ms; every 2.5 ms an interrupt is generated to the microprocessor, at which time the previous two samples (which have been buffered) are read and processed. Thus, every 2.5 ms, six words of rate data are input by the

Assume the following gyro characteristics:

range: ±500 deg/sec (8.72 rad/sec)

full scale deflection: ±10v

Rate→Gyro→Analog Data→A/D→		CTC Data→μP→Twos Comp	
500°/sec (8.72 rad/sec)	10v	F800H	07FFH
0°/sec (0 rad/sec)	0v	FFFFH	0000H
-500°/sec (-8.72 rad/sec)	-10v	07FEH	F801H

Table 3.1 Angular Rate - Digital Data Conversion

microprocessor - 2 each for yaw rate (r), pitch rate (q) and roll rate (p).

3.1.2 Integrate Rate Data

Integration of the rate data with respect to time allows the microprocessor to keep track of the rotation of the seat/occupant system about each of the axes. (Note that three separate integrations are required.) The integration scheme is based on the following formula for the trapezoidal rule:

$$A = \tfrac{1}{2}\Delta h \ (y_1 + 2y_2 + 2y_3 + \ldots + y_n) \tag{1}$$

The above was modified slightly to give the following formula:

$$2A/\Delta h = (0+y_1) + (0+y_2) + (y_1+y_3) + (y_2+y_4) + (y_3+y_5) + (y_4+y_6) + \ldots \tag{2}$$

where y_i corresponds to r_i, q_i, or p_i for a particular time t given by:

i = 1, 1200
t (number of ms after beginning of maneuver) = 1.25 (i)

Since data is sampled approximately every 1.25 ms, $\Delta h = 1.25$.

To perform the next step of the algorithm (update direction cosines), the program does not actually need to know the amount of rotation about each of the seat/occupant axes but only when the rotation has exceeded a predefined angle. Thus the A in eq. (2) is not calculated in the program but has been predetermined to insure that the left side of the equation becomes a constant against which the right side is tested. A is defined as the maximum angle that could be generated in one sampling period if rotating at the maximum rate that can be sensed by the gyroscope. In this case, the maximum rate is 8.72 rad/sec and the sampling period is 1.25 ms; therefore A = .0109 radians. Given the scaling used in the program, the left side of the equation is determined as follows:

$$A = .0109 \text{ radians} = 07FF_{16} = 2047_{10}$$

$$\frac{2A}{\Delta h} = \frac{2(2047)}{1.25} = \frac{4094}{1.25} = 3275 \cong CC0_{16}$$

If however, the seat/occupant system is rotating at the maximum rate in a negative direction (-8.72 rad/sec):

$$A = -.0109 \text{ rad such that}$$

$$\frac{2A}{\Delta h} = -CC0_{16} = F34B_{16}$$

Thus, the following three equations define the three integrations per-formed in the program:

$$\pm\ \text{CC0}\ =\ (0+r_1)+(0+r_2)+(r_1+r_3)+(r_2+r_4)+(r_3+r_5)+(r_4+r_6)+\ldots \qquad (3)$$

$$\pm\ \text{CC0}\ =\ (0+q_1)+(0+q_2)+(q_1+q_3)+(q_2+q_4)+(q_3+q_5)+(q_4+q_6)+\ldots \qquad (4)$$

$$\pm\ \text{CC0}\ =\ (0+p_1)+(0+p_2)+(p_1+p_3)+(p_2+p_4)+(p_3+p_5)+(p_4+p_6)+\ldots \qquad (5)$$

When the system has rotated at least .0109 radians in either a positive or negative direction around any of the 3 axes the appropriate direction cosines are updated and the corresponding test value ($\pm$ CC0) is subtracted from the sum; the integration then continues as before.

3.1.3 Update Direction Cosines

Implementation of this part of the vertical seeking algorithm is based on the Crowder Hession Direction Cosine Updating Algorithm as follows:

$$C_{31,a} = C_{31,K}$$
$$C_{32,a} = C_{32,K} - \Delta\theta_z\, C_{31,K}$$
$$C_{33,a} = C_{33,K} + \Delta\theta_y\, C_{31,K}$$

$$C_{31,b} = C_{31,a} + \Delta\theta_z\, C_{32,a}$$
$$C_{32,b} = C_{32,a}$$
$$C_{33,b} = C_{33,a} - \Delta\theta_x\, C_{32,a}$$

$$C_{31,K+1} = C_{31,b} - \Delta\theta_y\, C_{33,b}$$
$$C_{32,K+1} = C_{32,b} + \Delta\theta_x\, C_{33,b}$$
$$C_{33,K+1} = C_{33,b}$$

where:

C_{31}, C_{32}, C_{33} are the three direction cosines D_{31}, D_{32}, D_{33}, shown in Figure 2.2.

K,K+1 designate points in time;

a,b are values for intermediate calculations used in arriving at the next point in time, and

$\Delta\theta_x$, $\Delta\theta_y$ and $\Delta\theta_z$ are the angular displacements of the gyros.

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The displacements are represented by a quantum pulse weight $\Delta\theta$ which has the general form 2^{-n}, where n is determined by the sample time and the maximum value of the angular rates.

To maximize the resolution of this quantity the size of the quantum weight is required to be as small as possible but must be larger than the maximum rotation over one sample period. Given a maximum angular velocity of 8.72 radians/sec and a sample time of 1.25×10^{-3} seconds, the smallest quantum size that would be larger than the maximum angular displacement of the gyros (.0109 rad.) is 2^{-6} radians (= .0156 rad.). The quantum size used in the program is 2^{-7} (= .0078 rad.).

Every 2.5 ms (with each interrupt) this algorithm is processed twice, once for each of the two samples of input data. In processing the algorithm, $\Delta\theta_x$, $\Delta\theta_y$, $\Delta\theta_z$ are determined by the integration of the rotational rates around the x, y and z axes respectively, as follows:

For each axis,

     if the system has rotated less than .0109 radians in either a positive or negative direction, the corresponding $\Delta\theta_j = 0$;

     if the system has rotated at least .0109 radians in a positive direction, the corresponding $\Delta\theta_j = 2^{-7}$;

     if the system has rotated at least .0109 radians in a negative direction, the corresponding $\Delta\theta_j = -2^{-7}$.

In the program, there are three bytes of memory used as flag words (RLINC, PCINC, YAINC), each of which is set to one of three values (00, 01 or FF) when the rate data is integrated. The program then uses the value of the flag to determine which of the above three values (00, 2^{-7}, -2^{-7}) will be used (see Figure 3.1).

3.1.4 Generate Rocket Gimballing Commands

Two commands, a roll command and a pitch command, are output to gimbal the rocket and are calculated very straightforwardly as follows: Since, by their definition, the direction cosines are sinusoidal, a control law based on them would not be strictly linear. There are two distinct regions of seat attitude where different control aspects are to take place. First, in an inverted attitude ($-90° < \alpha_{33} < 90°$) a large command is needed to bring the seat upright. In this region, D33 is always positive, whereas D31 and D32 will vary from zero when $\alpha_{33} = 0°$ to ± 1 when $\alpha_{33} = 90°$. Second, in the upright attitude ($90° < \alpha_{33} < 270°$), D33 is always negative while D31 and D32 again vary between ± 1. The control law is shown in Figure 3.2.

RLINC

	$\Delta\theta_x$
00	00
01	2^{-7}
FF	-2^{-7}

→ System has not rotated at least .0109 radians in either direction around the x-axis.
→ System has rotated at least .0109 radians in a positive direction around the x-axis.
→ System has rotated at least .0109 radians in a negative direction around the x-axis.

PCINC

	$\Delta\theta_y$
00	00
01	2^{-7}
FF	-2^{-7}

→ System has not rotated at least .0109 radians in either direction around the y axis.
→ System has rotated at least .0109 radians in a positive direction around the y-axis.
→ System has rotated at least .0109 radians in a negative direction around the y-axis.

YAINC

	$\Delta\theta_z$
00	00
01	2^{-7}
FF	-2^{-7}

→ System has not rotated at least .0109 radians in either direction around the z-axis.
→ System has rotated at least .0109 radians in a positive direction around the z-axis.
→ System has rotated at least .0109 radians in a negative direction around the z-axis.

Figure 3.1   Quantum Control Chart

$$\underline{D33 \geq 0}$$

Roll Command = -D32
Pitch Command = D31

$$\underline{D33 < 0}$$

$$\underline{|D31| > |D32|}$$

Roll Command = -D32
Pitch Command = sign D31 $(2- | D31 |)$

$$\underline{|D32| \geq |D31|}$$

Roll Command = sign D32 $(2- | D32 |)$
Pitch Command = D31
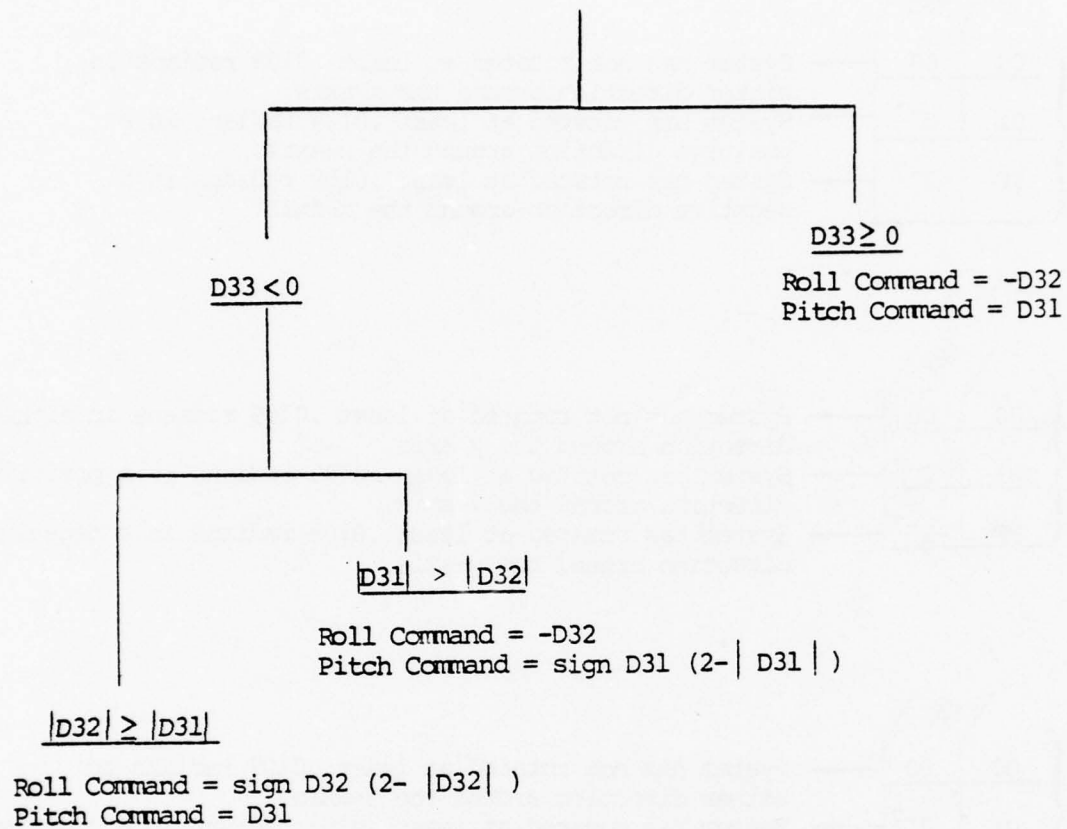
Figure 3.2 Control Law

3.1.5 Output Rocket Gimballing Commands

The seat-rocket motor arrangement as implemented at NWC is shown in Figure 3.3. It can be seen that the rocket motor can be gimballed $\pm$ 16° in two directions.

The two commands are output to a D/A converter, which in turn outputs a signal causing the rocket to move a certain angle. That angle is measured not from the current position of the rocket but from the neutral position.

3.2 Summary

Viewing the vertical seeking maneuver as a closed loop process as discussed in Section 3, it can be seen that the primary problem in implementing it in the feasibility demonstration program is that, although it is possible to simulate the input of the rate data, perform the required calculations to generate the rocket motor gimballing commands and display the outcome of these commands, the feedback effect of the rocket gimballing on the orientation of the seat/occupant system and on subsequent rate data is missing. It is not possible then to determine on the software development system whether the commands generated would produce the desired trajectory. However, using the rate data recorded at NWC, China Lake, it was possible to verify to a reasonable extent, the accuracy of the vertical seeking maneuver by inspecting the direction cosines of the final orientation. These are shown for both the 90° roll test and the 180° roll test in Figure 3.4. As stated in Section 2.1.7, some inaccuracy is expected due to the way in which the rate data was generated.

SEAT MOTOR ARRANGEMENT
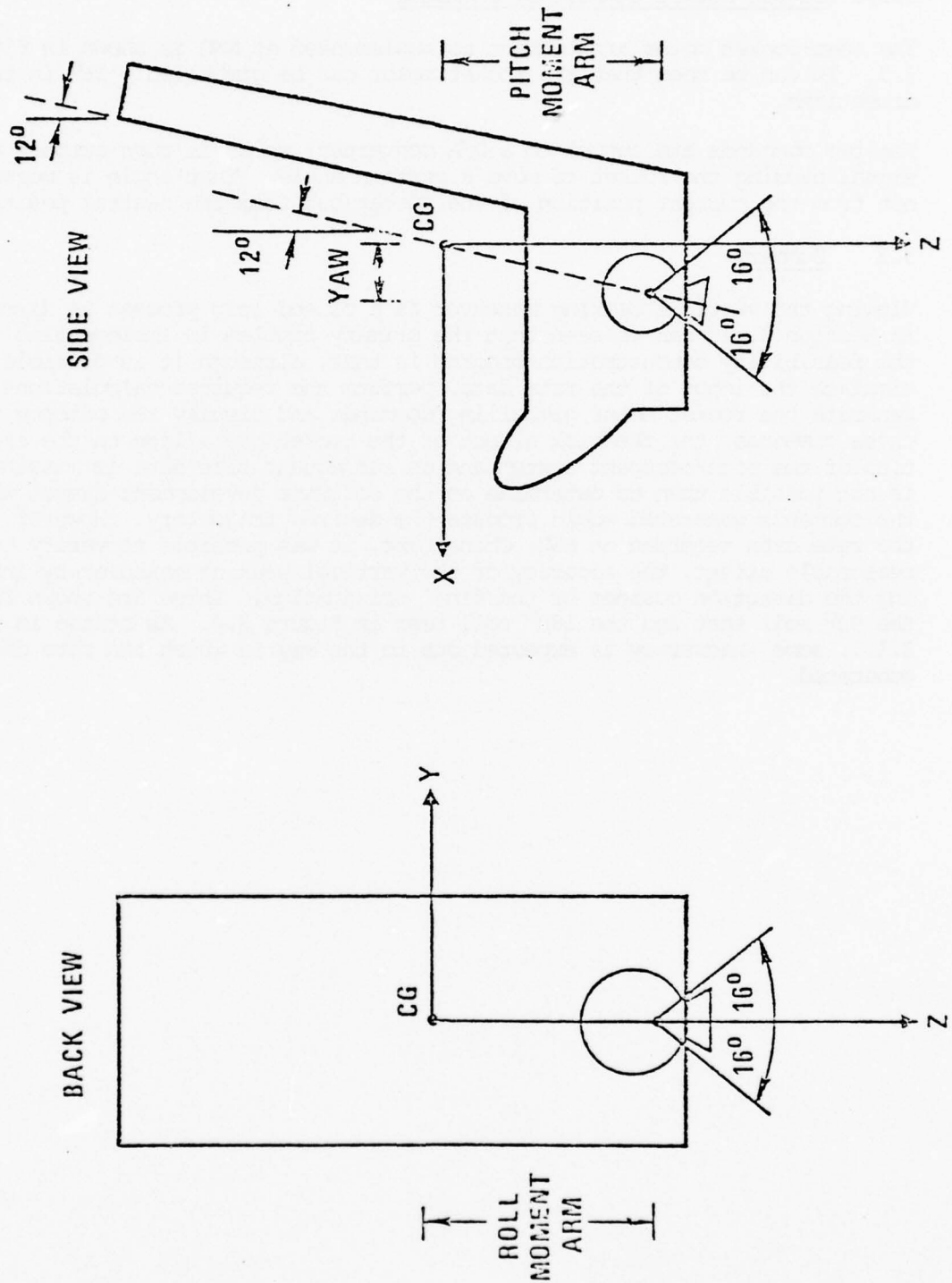
Figure 3.3   Seat/Motor Arrangement

90° Roll Test Final Orientation

D31 = -.184 $\rightarrow$ α31 = 100.6°
D32 = .004 $\rightarrow$ α32 = 89.77°
D33 = -.969 $\rightarrow$ α33 = 165.69°

180° Roll Test Final Orientation

D31 = .164 $\rightarrow$ α31 = 80.56°
D32 = .089 $\rightarrow$ α32 = 84.89°
D33 = -.970 $\rightarrow$ α33 = -165.93°

Figure 3.4 Results

4.   DEMONSTRATION PROGRAM

4.1 PROGRAM LISTING

```
0100                    ORG 100H
0100 00                     NOP
0101 F3                     DI
0102 318F37                 LXI SP,NEED30
0105 CD2601                 CALL INZRST75
0108 CD3201                 CALL INZTMRS
010B CD5401                 CALL INZDSP
010E CD3C0B                 CALL CHOICE
0111 CD6C01                 CALL INZDSK
0114 CD9C01                 CALL INZVRBLS
0117 CDFE01                 CALL INZRDATA
011A CD9D05                 CALL INZDRFTM
011D CD5401                 CALL INZDSP
0120 CD2F07                 CALL INZDEMO
0123 C34607                 JMP EJKEY
                INZRST75:
                ;
                ;SET UP RST 7.5
                ;(CANNOT LOAD PRGM INTO LOC 3C)
                ;
0126 213C00                 LXI H,3CH
0129 36C3                   MVI M,0C3H
012B 215C07                 LXI H,SEQSRT
012E 223D00                 SHLD 3DH
0131 C9                     RET
                INZTMRS:
0132 3E40                   MVI A,40H
0134 D3F3                   OUT 0F3H
0136 2103D1                 LXI H,0D103H   ;MODE SET
0139 3630                   MVI M,30H      ;T0,MO
013B 3670                   MVI M,70H      ;T1,MO
013D 36B0                   MVI M,0B0H     ;T2,MO
013F 2B                     DCX H          ;T2 LOC
0140 3601                   MVI M,1        ;1/2 US
0142 3600                   MVI M,0
0144 2B                     DCX H          ;T1 LOC
0145 3601                   MVI M,1        ;1/2 US
0147 3600                   MVI M,0
0149 2B                     DCX H          ;T0 LOC
014A 3601                   MVI M,1        ;1/2 US
014C 3600                   MVI M,0
                ;
                ;CLEAR UNWANTED INTERRUPTS
                ;
014E 3E1B                   MVI A,1BH
0150 CDD307                 CALL SIM
0153 C9                     RET
                INZDSP:
                ;CLEAR SCREEN, USE 40 CLMNS.,
                ;USE UPPER AND LOWER CASE
0154 CD00F8                 CALL 0F800H
0157 3E1B                   MVI A,1BH
0159 CD03F8                 CALL 0F803H ;40 COLMNS
015C 3E43                   MVI A,43H
015E CD03F8                 CALL 0F803H
0161 3E1B                   MVI A,1BH
0162 CD03F8                 CALL 0F803H
0166 3E55                   MVI A,55H
```

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```
0168 CD03F8              CALL OF803H
016B C9                 RET
                INZDSK:
                ;
                ;INITIALIZE FILE CONTROL BLOCKS
                ;AND OPEN ALL FILES
                ;
016C 210042             LXI H,FCBRD1
016F 3600               MVI M,0
0171 010C00             LXI B,12
0174 1E03               MVI E,3
0176 1616               MVI D,22
            LPM:
0178 09                 DAD B
            LPS:
0179 3600               MVI M,0
017B 23                 INX H
017C 15                 DCR D
017D C27901             JNZ LPS
0180 1616               MVI D,22
0182 2B                 DCX H
0183 1D                 DCR E
0184 C27801             JNZ LPM
0187 0E0F               MVI C,OPEN
0189 110042             LXI D,FCBRD1
018C CD0500             CALL BDOS
018F 112142             LXI D,FCBDRFTM
0192 CD0500             CALL BDOS
0195 114242             LXI D,FCBDEMO
0198 CD0500             CALL BDOS
019B C9                 RET
            INZVRBLS:
019C AF                 XRA A
019D 210000             LXI H,0
01A0 32F841             STA DCCT
01A3 32F441             STA SEQINDX
01A6 22EA41             SHLD YAWR
01A9 22EC41             SHLD PICHR
01AC 22EE41             SHLD ROLLR
01AF 22C441             SHLD YSUM1-2
01B2 22D041             SHLD YSUM2-2
01B5 22C841             SHLD PSUM1-2
01B8 22D441             SHLD PSUM2-2
01BB 22CC41             SHLD RSUM1-2
01BE 22D841             SHLD RSUM2-2
01C1 22C641             SHLD YSUM1
01C4 22D241             SHLD YSUM2
01C7 22CA41             SHLD PSUM1
01CA 22D641             SHLD PSUM2
01CD 22CE41             SHLD RSUM1
01D0 22DA41             SHLD RSUM2
01D3 32DD41             STA YAINC
01D6 32DE41             STA PCINC
01D9 32DF41             STA RLINC
01DC 32F541             STA TOGGL
01DF 210038             LXI H,3800H
01E2 22FA41             SHLD SCPTR
01E5 21B03C             LXI H,3CB0H
```

```
        01E8 22FC41              SHLD TLMPTR
        01EB 21E04A              LXI H,4AE0H
        01EE 22B241              SHLD VSPTR
        01F1 21C00C              LXI H,0CC0H
        01F4 22F041              SHLD QPOS
        01F7 2140F3              LXI H,0F340H
        01FA 22F241              SHLD QNEG
        01FD C9                  RET
                         INZRDATA:
                         ;
                         ;READ FILE WITH END POINTS
                         ;AND INTERPOLATE TO GET
                         ;1200 PIECES OF DATA EACH FOR
                         ;YAW,PITCH AND ROLL RATES
                         ;
        01FE 210036              LXI H,3600H
        0201 22E237              SHLD MOVPTR
        0204 0603                MVI B,3
                         SETUPIPS:
        0206 0E14                MVI C,READ
        0208 110042              LXI D,FCBRD1
        020B CD0500              CALL BDOS
                         ;
                         ;MOVE 80H BYTES TO INT PTS.STORAGE
                         ;
        020E 2AE237              LHLD MOVPTR
        0211 118000              LXI D,80H
                         MOVLOOP:
        0214 1A                  LDAX D
        0215 77                  MOV M,A
        0216 13                  INX D
        0217 23                  INX H
        0218 AF                  XRA A
        0219 BA                  CMP D
        021A CA1402              JZ MOVLOOP
        021D 22E237              SHLD MOVPTR
        0220 05                  DCR B
        0221 C20602              JNZ SETUPIPS
                         ;
                         ;SET UP TO INTERPOLATE YAW RATE DATA
                         ;
        0224 210036              LXI H,BEGYIP
        0227 22EA37              SHLD STRTPT
        022A 21E04A              LXI H,YRDATA
        022D 22E837              SHLD STRLOC
        0230 CD5202              CALL LINT
                         ;
                         ;SET UP TO INTERPOLATE PITCH RATE DATA
                         ;
        0233 217A36              LXI H,BEGPIP
        0236 22EA37              SHLD STRTPT
        0239 21E24A              LXI H,PRDATA
        023C 22E837              SHLD STRLOC
        023F CD5202              CALL LINT
                         ;
                         ;SET UP TO INTERPOLATE ROLL RATE DATA
                         ;
        0242 21F436              LXI H,BEGRIP
```

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```
       0245 22EA37              SHLD STRTPT
       0248 21E44A              LXI H,RRDATA
       024B 22E837              SHLD STRLOC
       024E CD5202              CALL LINT
       0251 C9                  RET
                         LINT:
                         ;
                         ;F(XI)=[FOX1-F1XO + (F1-F0)*XI]/[X1-XO]
                         ;
       0252 210000              LXI H,0
       0255 39                  DAD SP
       0256 22F637              SHLD LISVSP
       0259 31F637              LXI SP,LIJUNK
       025C 010000              LXI B,0000
       025F 110100              LXI D,1
       0262 C5                  PUSH B
       0263 D5                  PUSH D
       0264 C5                  PUSH B
       0265 2AEA37              LHLD STRTPT
       0268 F9                  SPHL
                         LILOOP:
       0269 E1                  POP H    ;FO
       026A 22C137              SHLD MLTP2
       026D 22F837              SHLD FZERO         ;FOR LATER
       0270 2AF437              LHLD XZERO
       0273 3E14                MVI A,20
       0275 85                  ADD L
       0276 6F                  MOV L,A  ;GET X1
       0277 7C                  MOV A,H
       0278 CE00                ACI O
       027A 67                  MOV H,A
       027B 22C737              SHLD MLTP1          ;FO X X1
       027E 210000              LXI H,0
       0281 39                  DAD SP
       0282 22E637              SHLD TMPSP
                         ;
                         ;SAVE STACK PTR BEFORE CALL MULT
                         ;
       0285 31CF37              LXI SP,SCRATCH
       0288 CD9403              CALL MULT
                         ;
                         ;PRODUCT OF MULT = FO X X1
                         ;
       028B 2AC137              LHLD ANSL
       028E 22FC37              SHLD FOX1L
       0291 2AC337              LHLD ANSM
       0294 22FE37              SHLD FOX1M
       0297 2AE637              LHLD TMPSP
       029A F9                  SPHL
       029B E1                  POP H    ;GET F1
       029C 3B                  DCX SP
       029D 3B                  DCX SP   ;=NXT FO
       029E 22C137              SHLD MLTP2
       02A1 22FA37              SHLD FONE
       02A4 2AF437              LHLD XZERO
       02A7 22C737              SHLD MLTP1
                         ;
                         ;NEXT XO = CURRENT XO + 20
```

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```
                        ;
    02AA 111400                 LXI D,20
    02AD 19                     DAD D
    02AE 22F437                 SHLD XZERO
    02B1 210000                 LXI H,0
    02B4 39                     DAD SP
    02B5 22E637                 SHLD TMPSP
    02B8 31CF37                 LXI SP,SCRATCH
    02BB CD9403                 CALL MULT
                        ;
                        ;PRODUCT FROM MULT = F1 X X0
                        ;
                        ;NOW COMPUTE F0X1 - F1X0
                        ;
    02BE 2AFC37                 LHLD F0X1L
    02C1 EB                     XCHG
    02C2 2AFE37                 LHLD F0X1M
    02C5 4D                     MOV C,L
    02C6 44                     MOV B,H
                        ;
                        ;BCDE - F0X1
                        ;
    02C7 2AC137                 LHLD ANSL
    02CA 7D                     MOV A,L
    02CB 2F                     CMA
    02CC C601                   ADI I
    02CE 6F                     MOV L,A
    02CF 7C                     MOV A,H
    02D0 2F                     CMA
    02D1 CE00                   ACI 0
    02D3 67                     MOV H,A
    02D4 22C137                 SHLD ANSL
    02D7 2AC337                 LHLD ANSM
    02DA 7D                     MOV A,L
    02DB 2F                     CMA
    02DC CE00                   ACI 0
    02DE 6F                     MOV L,A
    02DF 7C                     MOV A,H
    02E0 2F                     CMA
    02E1 CE00                   ACI 0
    02E3 67                     MOV H,A
    02E4 22C337                 SHLD ANSM
                        ;
                        ;ANSM/L = -F1X0
                        ;
    02E7 2AC137                 LHLD ANSL
    02EA 19                     DAD D
    02EB 22EC37                 SHLD ALSI
    02EE 2AC337                 LHLD ANSM
    02F1 D2F502                 JNC LICNI
    02F4 23                     INX H
                        LICNI:
    02F5 09                     DAD B
    02F6 22EE37                 SHLD AMSI
                        ;
                        ;COMPUTE F1 - F0
                        ;
    02F9 2AF837                 LHLD FZERO      -42-
```

```
        02FC 7D                 MOV A,L
        02FD 2F                 CMA
        02FE 4F                 MOV C,A
        02FF 7C                 MOV A,H
        0300 2F                 CMA
        0301 47                 MOV B,A
        0302 03                 INX B
        0303 2AFA37             LHLD FONE
        0306 09                 DAD B
        0307 22E437             SHLD F1MF0
                        LISUBLP:
                        ;
                        ;COMPUTE (F1-F0) X X(I)
                        ;
        030A 2AE437             LHLD F1MF0
        030D 22C737             SHLD MLTP1
        0310 2AF237             LHLD IVAL
        0313 22C137             SHLD MLTP2
        0316 23                 INX H
        0317 22F237             SHLD IVAL
        031A CD9403             CALL MULT
                        ;
                        ;COMP. (F0X1-F1X0)+(F1-F0)X X(I)
                        ;
        031D 2AEC37             LHLD ALST
        0320 EB                 XCHG
        0321 2AC137             LHLD ANSL
        0324 19                 DAD D
        0325 22D037             SHLD DVNDL
        0328 2AEE37             LHLD AMST
        032B EB                 XCHG
        032C 2AC337             LHLD ANSM
        032F D23303             JNC LICN2
        0332 23                 INX H
                        LICN2:
        0333 19                 DAD D
        0334 22D237             SHLD DVNDM
        0337 211400             LXI H,20
        033A 22D437             SHLD DVSRL
        033D 210000             LXI H,0
        0340 22D637             SHLD DVSRM
        0343 CD7E04             CALL DIVIDE
                        ;
                        ;QUOT.= (F0X1-F1X0)+(F1-F0)X X(I) / 20
                        ;WHERE 20 = X1-X0
                        ;
        0346 2AD837             LHLD QUOTL
        0349 EB                 XCHG
                        ;
                        ;STORE INTERPOLATED DATA POINT
                        ;
        034A 2AE837             LHLD STRLOC
        034D 73                 MOV M,E
        034E 23                 INX H
        034F 72                 MOV M,D
                        ;
                        ;INX BY 5 TO STORE NEXT DATA POINT
                        ;
```

```
        0350  110500              LXI D,5
        0353  19                  DAD D
        0354  22E837              SHLD STRLOC
                            ;19 PTS?
        0357  3AF037              LDA CTR20
        035A  3C                  INR A
        035B  32F037              STA CTR20
        035E  FE13                CPI 19
        0360  C20A03              JNZ LISUBLP
        0363  AF                  XRA A
        0364  32F037              STA CTR20
        0367  2AFA37              LHLD FONE
        036A  EB                  XCHG
        036B  2AE837              LHLD STRLOC
                            ;
                            ;STORE F1 AS 20TH POINT
                            ;
        036E  73                  MOV M,E
        036F  23                  INX H
        0370  72                  MOV M,D
        0371  110500              LXI D,5
        0374  19                  DAD D
        0375  22E837              SHLD STRLOC
                            ;
                            ;RESTORE STACK PTR TO GET NEW
                            ;END POINTS
                            ;
        0378  2AE637              LHLD TMPSP
        037B  F9                  SPHL
        037C  2AF237              LHLD IVAL
        037F  23                  INX H
        0380  22F237              SHLD IVAL
                            ;
                            ;HAVE 60X20 PTS BEEN GENERATED?
                            ;
        0383  3AF137              LDA CTR60
        0386  3C                  INR A
        0387  32F137              STA CTR60
        038A  FE3C                CPI 60
        038C  C26902              JNZ LILOOP
        038F  2AF637              LHLD LISVSP
        0392  F9                  SPHL
        0393  C9                  RET
                            MULT:
                            ;
                            ;ZERO OUT MST 1/2 ANS AND CARRY SAVE
                            ;
        0394  210000              LXI H,0000
        0397  22C337              SHLD ANSM
        039A  22C537              SHLD CARYSV
                            ;
                            ;DETERMINE SIGN OF ANSWER
                            ;
        039D  2AC737              LHLD MLTP1
        03A0  7C                  MOV A,H
        03A1  2AC137              LHLD MLTP2
        03A4  AC                  XRA H
        03A5  32CF37              STA SIGN
```

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```
        03A8 3E80                   MVI A,80H
                            ;
                            ;IF MLTP2<0, MLTP2=:MLTP2:
                            ;
        03AA A4                     ANA H
        03AB FC6904                 CM TC16
        03AE CD7104                 CALL CHKZERO
        03B1 22C137                 SHLD MLTP2
        03B4 2AC737                 LHLD MLTP1
        03B7 3E80                   MVI A,80H
                            ;
                            ;IF MLTP1<0, MLTP1=:MLTP1:
                            ;
        03B9 A4                     ANA H
        03BA FC6904                 CM TC16
        03BD CD7104                 CALL CHKZERO
        03C0 22C737                 SHLD MLTP1
                            ;
                            ;SAVE SP FOR RETURN
                            ;
        03C3 210000                 LXI H,0
        03C6 39                     DAD SP
        03C7 22C937                 SHLD MSVSP
                            ;
                            ;SET UP BIT COUNT
                            ;
        03CA 3E11                   MVI A,17
        03CC 32C037                 STA CNT
        03CF 31C137                 LXI SP,MLTP2
                      MLTLP:
        03D2 21FFFF                 LXI H,0FFFFH
        03D5 39                     DAD SP
        03D6 35                     DCR M
        03D7 CA4604                 JZ MLPDONE
                            ;
                            ;PUT TEST BIT INTO CARRY
                            ;
        03DA F1                     POP PSW
        03DB D22E04                 JNC BIT0
                      BIT1:
        03DE D1                     POP D
        03DF C1                     POP B
        03E0 E1                     POP H
                            ;D=MST 1/2 ANS
                            ;B=CARRY SAVE
                            ;H=1ST MULTIPLIER
                            ;
                            ;GET SUM WITHOUT CARRIES
                            ;
        03E1 78                     MOV A,B
        03E2 AA                     XRA D
        03E3 AC                     XRA H
        03E4 47                     MOV B,A
        03E5 79                     MOV A,C
        03E6 AB                     XRA E
        03E7 AD                     XRA L
        03E8 4F                     MOV C,A
        03E9 21FAFF                 LXI H,0FFFAH
```

```
03EC 39                        DAD SP
03ED F9                        SPHL
                         ;
                         ;COMPUTE NEW CARRY SAVE
                         ;
03EE E1                        POP H
03EF 7C                        MOV A,H
03F0 E1                        POP H
03F1 A4                        ANA H
03F2 57                        MOV D,A
03F3 7C                        MOV A,H
03F4 E1                        POP H
03F5 A4                        ANA H
03F6 B2                        ORA D
03F7 57                        MOV D,A
03F8 7C                        MOV A,H
03F9 21FAFF                    LXI H,0FFFAH
03FC 39                        DAD SP
03FD F9                        SPHL
03FE E1                        POP H
03FF A4                        ANA H
0400 B2                        ORA D
0401 57                        MOV D,A
0402 7D                        MOV A,L
0403 E1                        POP H
0404 A5                        ANA L
0405 5F                        MOV E,A
0406 7D                        MOV A,L
0407 E1                        POP H
0408 A5                        ANA L
0409 B3                        ORA E
040A 5F                        MOV E,A
040B 7D                        MOV A,L
040C 21FAFF                    LXI H,0FFFAH
040F 39                        DAD SP
0410 F9                        SPHL
0411 E1                        POP H
0412 A5                        ANA L
0413 B3                        ORA E
0414 5F                        MOV E,A
0415 E1                        POP H
                         MSTR:
                         ;
                         ;STORE NEW PS(I)
                         ;STORE NEW CS(I)
                         ;
0416 D5                        PUSH D
0417 C5                        PUSH B
0418 3B                        DCX SP
0419 3B                        DCX SP
041A D1                        POP D
041B C1                        POP B
                         ;
                         ;BCDE=PS(I)--MUST BE SHIFTED RIGHT
                         ;BY 1
                         ;
                         SHFT:
041C AF                        XRA A
```

```
041D 78                          MOV  A,B
041E 1F                          RAR
041F 47                          MOV  B,A
0420 79                          MOV  A,C
0421 1F                          RAR
0422 4F                          MOV  C,A
0423 7A                          MOV  A,D
0424 1F                          RAR
0425 57                          MOV  D,A
0426 7B                          MOV  A,E
0427 1F                          RAR
0428 5F                          MOV  E,A
0429 C5                          PUSH B
042A D5                          PUSH D
042B C3D203                      JMP  MLTLP
                       BITO:
                       ;
                       ;COMPUTE PS(I)
                       ;
042E D1                          POP  D
042F C1                          POP  B
0430 78                          MOV  A,B
0431 AA                          XRA  D
0432 47                          MOV  B,A
0433 79                          MOV  A,C
0434 AB                          XRA  E
0435 4F                          MOV  C,A
0436 3B                          DCX  SP
0437 3B                          DCX  SP
0438 3B                          DCX  SP
0439 3B                          DCX  SP
                       ;
                       ;COMPUTE CS(I)
                       ;
043A E1                          POP  H
043B 7C                          MOV  A,H
043C 5D                          MOV  E,L
043D E1                          POP  H
043E A4                          ANA  H
043F 57                          MOV  D,A
0440 7B                          MOV  A,E
0441 A5                          ANA  L
0442 5F                          MOV  E,A
0443 C31604                      JMP  MSTR
                       MLPDONE:
                       ;
                       ;COMPUTE PS(N) + CS(N)
                       ;
0446 33                          INX  SP
0447 33                          INX  SP
0448 E1                          POP  H
0449 C1                          POP  B
044A 09                          DAD  B
044B C5                          PUSH B
044C E5                          PUSH H
044D 2AC937                      LHLD MSVSP
0450 F9                          SPHL
                       ;
```

```
                              ;DETERMINE PROPER SIGN OF PRODUCT
                              ;
      0451 3ACF37             LDA SIGN
      0454 E680               ANI 80H
      0456 F0                 RP
      0457 2AC337             LHLD ANSM
      045A EB                 XCHG
      045B 2AC137             LHLD ANSL
      045E CD0205             CALL TWOSCOMP
      0461 22C137             SHLD ANSL
      0464 EB                 XCHG
      0465 22C337             SHLD ANSM
      0468 C9                 RET
                        TC16:
                              ;
                              ;SUBROUTINE TO TAKE TWOS COMPLEMENT
                              ;OF 16 BIT WORD HL
                              ;
      0469 7D                 MOV A,L
      046A 2F                 CMA
      046B 6F                 MOV L,A
      046C 7C                 MOV A,H
      046D 2F                 CMA
      046E 67                 MOV H,A
      046F 23                 INX H
      0470 C9                 RET
                        CHKZERO:
      0471 AF                 XRA A
      0472 BC                 CMP H
      0473 C0                 RNZ
      0474 BD                 CMP L
      0475 C0                 RNZ
      0476 210000             LXI H,0
      0479 22C137             SHLD ANSL
      047C C1                 POP B
      047D C9                 RET
                        DIVIDE:
                              ;
                              ;DIVIDE BY REPEATED SUBTRACTIONS
                              ;THEN ROUND QUOTIENT TO NEAREST
                              ;INTEGER
                              ;
      047E 21FFFF             LXI H,0FFFFH
      0481 22D837             SHLD QUOTL
      0484 22DA37             SHLD QUOTM
                              ;
                              ;DETERMINE SIGN OF QUOTIENT
                              ;
      0487 2AD637             LHLD DVSRM
      048A 7C                 MOV A,H
      048B 2AD237             LHLD DVNDM
      048E AC                 XRA H
      048F 32CF37             STA SIGN
                              ;
                              ;IF DVND<0, DVND=!DVND!
                              ;
      0492 7C                 MOV A,H
      0493 E680               ANI 80H
```

```
        0495 F2A604              JP CKDVSR
        0498 EB                  XCHG
        0499 2AD037              LHLD DVNDL
        049C CD0205              CALL TWOSCOMP
        049F 22D037              SHLD DVNDL
        04A2 EB                  XCHG
        04A3 22D237              SHLD DVNDM
                         CKDVSR:
                         ;
                         ;IF DVSR<0, DVSR=:DVSR:
                         ;
        04A6 2AD637              LHLD DVSRM
        04A9 7C                  MOV A,H
        04AA E680                ANI 80H
        04AC F2BD04              JP DOCKS
        04AF EB                  XCHG
        04B0 2AD437              LHLD DVSRL
        04B3 CD0205              CALL TWOSCOMP
        04B6 22D437              SHLD DVSRL
        04B9 EB                  XCHG
        04BA 22D637              SHLD DVSRM
                         DOCKS:
                         ;
                         ;IS DVSR 0 OR 1?
                         ;
        04BD EB                  XCHG
        04BE 2AD437              LHLD DVSRL
        04C1 EB                  XCHG
        04C2 AF                  XRA A
        04C3 B4                  ORA H
        04C4 B5                  ORA L
        04C5 B2                  ORA D
        04C6 C2D204              JNZ CKDNO
        04C9 B3                  ORA E
        04CA CA0105              JZ DIVZERO
        04CD FE01                CPI 1
        04CF CAEB04              JZ DIVONE
                         CKDNO:
                         ;
                         ;IV DVND=0,QUOT = 0
                         ;
        04D2 AF                  XRA A
        04D3 2AD237              LHLD DVNDM
        04D6 EB                  XCHG
        04D7 2AD037              LHLD DVNDL
        04DA B2                  ORA D
        04DB B3                  ORA E
        04DC B4                  ORA H
        04DD B5                  ORA L
        04DE C23405              JNZ SETUP
                         QUOTO:
        04E1 210000              LXI H,0
        04E4 22DA37              SHLD QUOTM
        04E7 22D837              SHLD QUOTL
        04EA C9                  RET
                         DIVONE:
                         ;
                         ;IF DVSR=1,QUOT=DVND
```

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```
                         ;
    04EB 2AD237                    LHLD DVNDM
    04EE EB                       XCHG
    04EF 2AD037                   LHLD DVNDL
    04F2 3ACF37                   LDA SIGN
    04F5 AA                       XRA D
    04F6 FC0205                   CM TWOSCOMP
    04F9 22D837                   SHLD QUOTL
    04FC EB                       XCHG
    04FD 22DA37                   SHLD QUOTM
    0500 C9                       RET
                         DIVZERO:
    0501 76                       HLT
                         TWOSCOMP:
                         ;
                         ;SUBROUTINE TAKES 2'S COMP.
                         ;OF 32 BITS IN DEHL
                         ;
    0502 7D                       MOV A,L
    0503 2F                       CMA
    0504 C601                     ADI 1
    0506 6F                       MOV L,A
    0507 7C                       MOV A,H
    0508 2F                       CMA
    0509 CE00                     ACI 0
    050B 67                       MOV H,A
    050C 7B                       MOV A,E
    050D 2F                       CMA
    050E CE00                     ACI 0
    0510 5F                       MOV E,A
    0511 7A                       MOV A,D
    0512 2F                       CMA
    0513 CE00                     ACI 0
    0515 57                       MOV D,A
    0516 C9                       RET
                         INCQUOT:
                         ;
                         ;INCR. QUOT WITH EACH SUCCESSFUL
                         ;SUBTRACTION
                         ;
    0517 2AD837                   LHLD QUOTL
    051A 7D                       MOV A,L
    051B C601                     ADI 1
    051D 6F                       MOV L,A
    051E 7C                       MOV A,H
    051F CE00                     ACI 0
    0521 67                       MOV H,A
    0522 22D837                   SHLD QUOTL
    0525 2ADA37                   LHLD QUOTM
    0528 7D                       MOV A,L
    0529 CE00                     ACI 0
    052B 6F                       MOV L,A
    052C 7C                       MOV A,H
    052D CE00                     ACI 0
    052F 67                       MOV H,A
    0530 22DA37                   SHLD QUOTM
    0533 C9                       RET
                         SETUP:
```

```
                        ;
                        ;SET DVSR= -DVSR TO DO SUBTRACTION
                        ;
        0534 2AD637             LHLD DVSRM
        0537 EB                 XCHG
        0538 2AD437             LHLD DVSRL
        053B CD0205             CALL TWOSCOMP
        053E 44                 MOV B,H
        053F 4D                 MOV C,L
                        DIVLP:
        0540 CD1705             CALL INCQUOT
        0543 2AD037             LHLD DVNDL
        0546 22DC37             SHLD REML
        0549 09                 DAD B
        054A 22D037             SHLD DVNDL
        054D 2AD237             LHLD DVNDM
        0550 22DE37             SHLD REMM
        0553 7D                 MOV A,L
        0554 8B                 ADC E
        0555 6F                 MOV L,A
        0556 7C                 MOV A,H
        0557 8A                 ADC D
        0558 67                 MOV H,A
        0559 22D237             SHLD DVNDM
        055C DA4005             JC DIVLP
        055F 2ADC37             LHLD REML
        0562 7D                 MOV A,L
        0563 17                 RAL
        0564 6F                 MOV L,A
        0565 7C                 MOV A,H
        0566 17                 RAL
        0567 67                 MOV H,A
        0568 22DC37             SHLD REML
        056B 2ADE37             LHLD REMM
        056E 7D                 MOV A,L
        056F 17                 RAL
        0570 6F                 MOV L,A
        0571 7C                 MOV A,H
        0572 17                 RAL
        0573 67                 MOV H,A
        0574 22DE37             SHLD REMM
        0577 2ADC37             LHLD REML
        057A 09                 DAD B
        057B 2ADE37             LHLD REMM
        057E 7D                 MOV A,L
        057F 8B                 ADC E
        0580 7C                 MOV A,H
        0581 8A                 ADC D
        0582 DC1705             CC INCQUOT
        0585 3ACF37             LDA SIGN
        0588 E680              ANI 80H
        058A F0                 RP
        058B 2ADA37             LHLD QUOTM
        058E EB                 XCHG
        058F 2AD837             LHLD QUOTL
        0592 CD0205             CALL TWOSCOMP
        0595 22D837             SHLD QUOTL
        0598 EB                 XCHG
```

```
0599 22DA37              SHLD QUOTM
059C C9                  RET
                  INZDRFTM:
                  ;
                  ;GET INITIAL ALTITUDE AND SPEED
                  ;FROM CRT AND DETERMINE
                  ;PARACHUTE DISREEFING TIME
059D 0E14                MVI C,READ
059F 112142              LXI D,FCBDRFTM
05A2 CD0500              CALL BDOS
                  GETALT:
05A5 118000              LXI D,80H
05A8 0E09.               MVI C,PRINT
05AA CD0500              CALL BDOS
                  RDALT:
05AD 0E0A                MVI C,INLINE
05AF 116041              LXI D,INBUF
05B2 CD0500              CALL BDOS
05B5 216141              LXI H,INBUF+1
05B8 7E                  MOV A,M
05B9 FE06                CPI 6
05BB 4F                  MOV C,A
05BC D21F07              JNC AINVENT
05BF 23                  INX H
05C0 CDB706              CALL ASBCD
05C3 DA1F07              JC AINVENT
05C6 116141              LXI D,INBUF+1
05C9 1A                  LDAX D
05CA 13                  INX D
05CB D605                SUI 5
05CD 0E05                MVI C,5
05CF 217441              LXI H,INBUF+20
05D2 CDC806              CALL PREP
05D5 217441              LXI H,INBUF+20
05D8 110000              LXI D,0
05DB CDDF06              CALL TNTHOUS
05DE 22B641              SHLD ALT
05E1 01AFB9              LXI B,-18001
05E4 09                  DAD B
05E5 DA1F07              JC AINVENT
                  ;GET SPEED
05E8 0E09                MVI C,PRINT
05EA 11AE00              LXI D,0AEH
05ED CD0500              CALL BDOS
                  RDSPEED:
05F0 116041              LXI D,INBUF
05F3 0E0A                MVI C,INLINE
05F5 CD0500              CALL BDOS
05F8 216141              LXI H,INBUF+1
05FB 7E                  MOV A,M
05FC FE04                CPI 4
05FE 4F                  MOV C,A
05FF D22707              JNC SINVENT
0602 23                  INX H
0603 CDB706              CALL ASBCD
0606 DA2707              JC SINVENT
0609 116141              LXI D,INBUF+1
060C 1A                  LDAX D
```

```
060D 13                          INX D
060E D603                        SUI 3
0610 0E03                        MVI C,3
0612 217441                      LXI H,INBUF+20
0615 CDC806                      CALL PREP
0618 217441                      LXI H,INBUF+20
061B 110000                      LXI D,0
061E CDFB06                      CALL HUNDS
0621 22B841                      SHLD SPEED
0624 01A7FD                      LXI B,-601
0627 09                          DAD B
0628 DA2707                      JC SINVENT
062B 2AB641                      LHLD ALT
062E 0150C9                      LXI B,-14000
0631 09                          DAD B
0632 DAB006                      JC T4PT5
0635 2AB641                      LHLD ALT
0638 0190E8                      LXI B,-6000
063B 09                          DAD B
063C D2A906                      JNC T1PT5
063F 2AB841                      LHLD SPEED
0642 0110FF                      LXI B,-240
0645 09                          DAD B
0646 D2A906                      JNC T1PT5
0649 211600                      LXI H,22
064C 22C737                      SHLD MLTP1
064F 2AB841                      LHLD SPEED
0652 22C137                      SHLD MLTP2
0655 CD9403                      CALL MULT
0658 2AB841                      LHLD SPEED
065B 29                          DAD H    ; 2X S
065C 22D037                      SHLD DVNDL
065F 210000                      LXI H,0
0662 22D237                      SHLD DVNDM
0665 22D637                      SHLD DVSRM
0668 210A00                      LXI H,10
066B 22D437                      SHLD DVSRL
066E CD7E04                      CALL DIVIDE
                             ;QUOT = .2XS
                             ;CALC. 22.2XS
0671 2AD837                      LHLD QUOTL
0674 EB                          XCHG
0675 2AC137                      LHLD ANSL
0678 19                          DAD D
0679 22C137                      SHLD ANSL
067C 2AB841                      LHLD SPEED
067F 29                          DAD H
0680 22D037                      SHLD DVNDL
0683 210000                      LXI H,0
0686 22D237                      SHLD DVNDM
0689 22D637                      SHLD DVSRM
068C 216400                      LXI H,100
068F 22D437                      SHLD DVSRL
0692 CD7E04                      CALL DIVIDE
0695 2AD837                      LHLD QUOTL
0698 EB                          XCHG
0699 2AC137                      LHLD ANSL
069C 19                          DAD D
```

```
                              ;HL = 22.22XSPEED
        069D 117BB4                    LXI D,-19333
        06A0 19                        DAD D
        06A1 EB                        XCHG
        06A2 2AB641                    LHLD ALT
        06A5 19                        DAD D
        06A6 DAB006                    JC T4PT5
                      T1PT5:
        06A9 215802                    LXI H,600
        06AC 22B441                    SHLD PDRFTM
        06AF C9                        RET
                      T4PT5:
        06B0 210807                    LXI H,1800
        06B3 22B441                    SHLD PDRFTM
        06B6 C9                        RET
                              ;CONVERT ASCII-8 BIT BCD
                      ASBCD:
        06B7 7E                        MOV A,M
        06B3 FE30                      CPI 30H
        06BA D8                        RC
        06BB FE3A                      CPI 3AH
        06BD 3F                        CMC
        06BE D8                        RC
                              ;OK IF BETWEEN 0,9
        06BF D630                      SUI 30H
        06C1 77                        MOV M,A
        06C2 23                        INX H
        06C3 0D                        DCR C
        06C4 C2B706                    JNZ ASBCD
        06C7 C9                        RET
                      PREP:
        06C8 FE00                      CPI 0
        06CA CAD606                    JZ PREP2
        06CD 3600                      MVI M,0
        06CF 23                        INX H
        06D0 3C                        INR A
        06D1 0D                        DCR C
        06D2 C2C806                    JNZ PREP
        06D5 C9                        RET
                      PREP2:
        06D6 1A                        LDAX D
        06D7 77                        MOV M,A
        06D8 13                        INX D
        06D9 23                        INX H
        06DA 0D                        DCR C
        06DB C2D606                    JNZ PREP2
        06DE C9                        RET
                              ;
                              ;CONVERT 8 BIT BCD TO HEX
                              ;
                      TNTHOUS:
        06DF 7E                        MOV A,M
        06E0 23                        INX H
        06E1 FE02                      CPI 2
        06E3 DAEA06                    JC TNTCNT
        06E6 F1                        POP H
        06E7 C31F07                    JMP AINVENT
                      TNTCNT:
```

```
    06EA FE01                      CPI 1
    06EC C2F206                    JNZ THOUS
    06EF 111027                    LXI D,10000
                        THOUS:
    06F2 7E                        MOV A,M
    06F3 23                        INX H
    06F4 01E803                    LXI B,1000
    06F7 CD1607                    CALL BCDHEX
    06FA EB                        XCHG
                        HUNDS:
    06FB 7E                        MOV A,M
    06FC 23                        INX H
    06FD 016400                    LXI B,100
    0700 CD1607                    CALL BCDHEX
    0703 EB                        XCHG
                        TENS:
    0704 7E                        MOV A,M
    0705 23                        INX H
    0706 010A00                    LXI B,10
    0709 CD1607                    CALL BCDHEX
    070C EB                        XCHG
                        UNITS:
    070D 7E                        MOV A,M
    070E 23                        INX H
    070F 010100                    LXI B,1
    0712 CD1607                    CALL BCDHEX
    0715 C9                        RET
                        BCDHEX:
    0716 EB                        XCHG
                        BHLP:
    0717 FE00                      CPI 0
    0719 C8                        RZ
    071A 09                        DAD B
    071B 3D                        DCR A
    071C C31707                    JMP BHLP
                        AINVENT:
                        ;
                        ;INVALID ALTITUDE ENTERED
                        ;
    071F 3E04                      MVI A,4
    0721 CD03F8                    CALL 0F803H
    0724 C3AD05                    JMP RDALT
                        SINVENT:
                        ;
                        ;INVALID SPEED ENTERED
                        ;
    0727 3E04                      MVI A,4
    0729 CD03F8                        CALL 0F803H
    072C C3F005                    JMP RDSPEED
                        INZDEMO:
    072F 0604 ·                    MVI B,4
                        INZDMLP:
    0731 0E14                      MVI C,READ
    0733 114242                    LXI D,FCBDEMO
    0736 CD0500                    CALL BDOS
    0739 0E09                      MVI C,PRINT
    073B 118000                    LXI D,80H
    073E CD0500                    CALL BDOS
```

```
0741 05                     DCR  B
0742 C23107                 JNZ  INZDMLP
0745 C9                     RET
                  EJKEY:
0746 0E01                   MVI  C,CONIN
0748 CD0500                 CALL BDOS
074B FE45                   CPI  'E'
074D CA7F07                 JZ   EJECT
0750 3E7F                   MVI  A,7FH
0752 CD03F8                 CALL OF803H
0755 C34607                 JMP  EJKEY
                  WAITING:
0758 FB                     EI
                  HERE:
0759 C35907                 JMP  HERE  ;WAIT FOR INTERRUPT
                  SEQSRT:
075C 2ABA41                 LHLD INTCNTR
075F 23                     INX  H
0760 22BA41                 SHLD INTCNTR
0763 318F37                 LXI  SP,NEED30
0766 217307                 LXI  H,JMPSTRT
0769 3AF441                 LDA  SEQINDX
076C 4F                     MOV  C,A
076D 0600                   MVI  B,0
076F 09                     DAD  B
0770 09                     DAD  B
0771 09                     DAD  B
0772 E9                     PCHL
                  JMPSTRT:
0773 C3B707                 JMP  EJCTRTN
0776 C3BF07                 JMP  CTPLTRTN
0779 C38F08                 JMP  RKTSEQ
077C C3450A                 JMP  PARSEP
                  EJECT:
077F 2103D1                 LXI  H,0D103H
0782 3674                   MVI  M,74H
0784 2101D1                 LXI  H,0D101H
0787 3650                   MVI  M,50H
0789 36C3                   MVI  M,0C3H
078B 3E1B                   MVI  A,1BH
078D CDDB07                 CALL SIM
0790 3E0B                   MVI  A,0BH
0792 CDDB07                 CALL SIM
0795 318F37                 LXI  SP,NEED30
0798 3E04                   MVI  A,4
079A CD03F8                 CALL OF803H
079D 3E1B                   MVI  A,ESC
079F CD03F8                 CALL OF803H
07A2 3E3D                   MVI  A,'='
07A4 CD03F8                 CALL OF803H
07A7 3E21                   MVI  A,21H
07A9 CD03F8                 CALL OF803H
07AC 3E47                   MVI  A,47H
07AE CD03F8                 CALL OF803H
07B1 210000                 LXI  H,0
07B4 22BA41                 SHLD INTCNTR
                  EJCTRTN:
07B7 0E06                   MVI  C,6
```

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```
       07B9 CDC707              CALL SQUIB
       07BC C3E207              JMP DRIVER
                      CTPLTRTN:
       07BF 0E02                MVI C,2
       07C1 CDC707              CALL SQUIB
       07C4 C3E207              JMP DRIVER
                      SQUIB:
       07C7 3E0A                MVI A,0AH
       07C9 CD03F8              CALL 0F803H
       07CC 3E08                MVI A,BS
       07CE CD03F8              CALL 0F803H
       07D1 3E2A                MVI A,LGT
       07D3 CD03F8              CALL 0F803H
       07D6 0D                  DCR C
       07D7 C2C707              JNZ SQUIB
       07DA C9                  RET
                      SIM:
       07DB 21E007              LXI H,SIM1
       07DE 3630                MVI M,30H
                      SIM1:
       07E0 00                  NOP
       07E1 C9                  RET
                      DRIVER:
       07E2 3AF441              LDA SEQINDX
       07E5 4F                  MOV C,A
       07E6 0600                MVI B,0
       07E8 21EF07              LXI H,DRVRCK
       07EB 09                  DAD B
       07EC 09                  DAD B
       07ED 09                  DAD B
       07EE E9                  PCHL
                      DRVRCK:
       07EF C3F807              JMP DRCKA
       07F2 C32108              JMP DRCKB
       07F5 C35508              JMP DRCKC
                      DRCKA:
       07F8 2ABA41              LHLD INTCNTR
       07FB 01F5FF              LXI B,0FFF5H
       07FE 09                  DAD B
       07FF DA1908              JC SSQB
       0802 3E1B                MVI A,1BH
       0804 CD03F8              CALL 0F803H
       0807 3E3D                MVI A,'='
       0809 CD03F8              CALL 0F803H
       080C 3E21                MVI A,21H
       080E CD03F8              CALL 0F803H
       0811 3E47                MVI A,47H
       0813 CD03F8              CALL 0F803H
       0816 C35807              JMP WAITING
                      SSQB:
       0819 3E01                MVI A,1
       081B 32F441              STA SEQINDX
       081E C35807              JMP WAITING
                      DRCKB:
       0821 2ABA41              LHLD INTCNTR
       0824 01EBFF              LXI B,0FFEBH
       0827 09                  DAD B
       0828 DA4208              JC SSQC
```

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```
       082B 3E1B              MVI A,1BH
       082D CD03F8            CALL 0F803H
       0830 3E3D              MVI A,'='
       0832 CD03F8            CALL 0F803H
       0835 3E27              MVI A,27H
       0837 CD03F8            CALL 0F803H
       083A 3E47              MVI A,47H
       083C CD03F8            CALL 0F803H
       083F C35807            JMP WAITING
                      SSQC:
       0842 2101D1            LXI H,0D101H
       0845 3688             MVI M,88H
       0847 3613             MVI M,13H
       0849 3E01             MVI A,1
       084B 32BC41            STA RKTFLG
       084E 3C               INR A
       084F 32F441            STA SEQINDX
       0852 C35807            JMP WAITING
                      DRCKC:
       0855 3ABC41            LDA RKTFLG
       0858 FE01             CPI 1
       085A CA7403            JZ ADJCNTR
       085D 2ABA41            LHLD INTCNTR
       0860 01A8FD            LXI B,-600
       0863 09               DAD B
       0864 D25807            JNC WAITING
                      SSQD:
       0867 3E03             MVI A,3
       0869 32F441            STA SEQINDX
       086C 0E01             MVI C,1
       086E CDC707            CALL SQUIB
       0871 C3450A            JMP PARSEP
                      ADJCNTR:
       0874 2ABA41            LHLD INTCNTR
       0877 22BD41            SHLD TWNTYFV
       087A 210000            LXI H,0
       087D 22BA41            SHLD INTCNTR
       0880 AF               XRA A
       0881 32BC41            STA RKTFLG
       0884 C35807            JMP WAITING
                      RKFSTM:
       0887 0E02             MVI C,2
       0889 CDC707            CALL SQUIB
       088C C3E207            JMP DRIVER
                      RKTSEQ:
       088F 3ABC41            LDA RKTFLG
       0892 FE01             CPI 1
       0894 CA8703            JZ RKFSTM
                      CKPCEM:
       0897 2ABA41            LHLD INTCNTR
       089A 110802            LXI D,520
       089D 7A               MOV A,D
       089E BC               CMP H
       089F C2A908            JNZ INKATDTA
       08A2 0E01             MVI C,1
       08A4 7B               MOV A,E
       08A5 BD               CMP L
       08A6 CCC707            CZ SQUIB
```

```
                      INRATDTA:
     08A9 3E06                 MVI A,6
     08AB 010000               LXI B,0
     08AE 21C341               LXI H,41C3H
     08B1 22B041               SHLD VSINP
                      INLOOP:
     08B4 2AB241               LHLD VSPTR
     08B7 09                   DAD B
     08B8 03                   INX B
     08B9 5E                   MOV E,M
     08BA 23                   INX H
     08BB 56                   MOV D,M
     08BC 2AB041               LHLD VSINP
     08BF F9                   SPHL
     08C0 210200               LXI H,2
     08C3 39                   DAD SP
     08C4 22B041               SHLD VSINP
     08C7 2B                   DCX H
     08C8 2B                   DCX H
     08C9 09                   DAD B
     08CA 03                   INX B
     08CB F9                   SPHL
     08CC E3                   XTHL
     08CD 19                   DAD D
     08CE EB                   XCHG
     08CF E3                   XTHL
     08D0 23                   INX H
     08D1 23                   INX H
     08D2 73                   MOV M,E
     08D3 23                   INX H
     08D4 72                   MOV M,D
     08D5 3D                   DCR A
     08D6 C2B408               JNZ INLOOP
     08D9 2AB241               LHLD VSPTR
     08DC 09                   DAD B
     08DD 22B241               SHLD VSPTR
     08E0 318F37               LXI SP,NEED30
                      RKTCONT:
     08E3 CDEC08               CALL UPDAT
     08E6 CDB609               CALL CNTRLAW
     08E9 C3E207               JMP DRIVER
                      UPDAT:
     08EC 210000               LXI H,0
     08EF 39                   DAD SP
     08F0 22F641               SHLD SAVE
     08F3 31C641               LXI SP,YSUM1
                      RESID:
     08F6 D1                   POP D
     08F7 2AEA41               LHLD YAWR
     08FA CD7B09               CALL UPLOG
     08FD 22EA41               SHLD YAWR
     0900 32DD41               STA YAINC
     0903 D1                   POP D
     0904 D1                   POP D
     0905 2AEC41               LHLD PICHR
     0908 CD7B09               CALL UPLOG
     090B 22EC41               SHLD PICHR
     090E 32DE41               STA PCINC
```

```
0911 D1              POP D
0912 D1              POP D
0913 2AEE41          LHLD ROLLR
0916 CD7B09          CALL UPLOG
0919 22EE41          SHLD ROLLR
091C 32DF41          STA RLINC
091F 31E241          LXI SP,D31
0922 C1              POP B
0923 E1              POP H
0924 3ADD41          LDA YAINC
0927 2F              CMA
0928 3C              INR A
0929 CD9D09          CALL INDIS
092C E3              XTHL
092D 3ADE41          LDA PCINC
0930 CD9D09          CALL INDIS
0933 E3              XTHL
0934 E5              PUSH H
0935 C1              POP B
0936 E1              POP H
0937 3ADF41          LDA RLINC
093A 2F              CMA
093B 3C              INR A
093C CD9D09          CALL INDIS
093F E5              PUSH H
0940 2AE241          LHLD D31
0943 3ADD41          LDA YAINC
0946 CD9D09          CALL INDIS
0949 C5              PUSH B
094A E3              XTHL
094B D1              POP D
094C C1              POP B
094D 3ADF41          LDA RLINC
0950 CD9D09          CALL INDIS
0953 C5              PUSH B
0954 3B              DCX SP
0955 3B              DCX SP
0956 E3              XTHL
0957 3ADE41          LDA PCINC
095A 2F              CMA
095B 3C              INR A
095C CD9D09          CALL INDIS
095F E5              PUSH H
0960 3AF541          LDA TOGGL
0963 FE01            CPI 1
0965 D27209          JNC UPDON
0968 3C              INR A
0969 32F541          STA TOGGL
096C 31D241          LXI SP,YSUM2
096F C3F608          JMP RESID
            UPDON:
0972 AF              XRA A
0973 32F541          STA TOGGL
0976 2AF641          LHLD SAVE
0979 F9              SPHL
097A C9              RET
            UPLOG:
097B 19              DAD D
```

```
        097C 3E80              MVI A,80H
        097E A4                ANA H
        097F EB                XCHG
        0980 C29009            JNZ NEGRS
        0983 2AF241            LHLD QNEG
        0986 19                DAD D
        0987 3E80              MVI A,80H
        0989 A4                ANA H
        098A 3E01              MVI A,1
        098C C8                RZ
        098D EB                XCHG
        098E AF                XRA A
        098F C9                RET
                       NEGRS:
        0990 2AF041            LHLD QPOS
        0993 19                DAD D
        0994 3E80              MVI A,80H
        0996 A4                ANA H
        0997 3EFF              MVI A,OFFH
        0999 C0                RNZ
        099A EB                XCHG
        099B AF                XRA A
        099C C9                RET
                       INDIS:
        099D FE00              CPI 0
        099F C8                RZ
        09A0 78                MOV A,B
        09A1 F2A609            JP LABEL
        09A4 2F                CMA
        09A5 3C                INR A
                       LABEL:
        09A6 5F                MOV E,A
        09A7 E680              ANI 80H
        09A9 F2B109            JP POSBY
        09AC 16FF              MVI D,OFFH
        09AE 19                DAD D
        09AF 19                DAD D
        09B0 C9                RET
                       POSBY:
        09B1 1600              MVI D,0
        09B3 19                DAD D
        09B4 19                DAD D
        09B5 C9                RET
                       CNTRLAW:
        09B6 3AE741            LDA D33+1
        09B9 17                RAL
        09BA DACE09            JC D33LO
        09BD 3AE341            LDA D31+1
        09C0 EE7F              XRI 7FH
        09C2 67                MOV H,A
                       NEGD2:
        09C3 3AE541            LDA D32+1
        09C6 2F                CMA
        09C7 3C                INR A
        09C8 EE7F              XRI 7FH
        09CA 6F                MOV L,A
        09CB C3050A            JMP OUTPUT
                       D33LO:
```

```
       09CE 3AE341              LDA D31+1
       09D1 CD370A              CALL ABS
       09D4 4F                  MOV C,A
       09D5 5A                  MOV E,D
       09D6 3AE541              LDA D32+1
       09D9 CD370A              CALL ABS
       09DC B9                  CMP C
       09DD D2F109              JNC D32G
       09E0 3E7F                MVI A,7FH
       09E2 91                  SUB C
       09E3 4F                  MOV C,A
       09E4 7B                  MOV A,E
       09E5 FE80                CPI 80H
       09E7 79                  MOV A,C
       09E8 CC420A              CZ CHS
       09EB EE7F                XRI 7FH
       09ED 67                  MOV H,A
       09EE C3C309              JMP NEGD2
                       D32G:
       09F1 3E7F                MVI A,7FH
       09F3 90                  SUB B
       09F4 47                  MOV B,A
       09F5 7A                  MOV A,D
       09F6 FE80                CPI 80H
       09F8 78                  MOV A,B
       09F9 C4420A              CNZ CHS
       09FC EE7F                XRI 7FH
       09FE 6F                  MOV L,A
       09FF 3AE341              LDA D31+1
       0A02 EE7F                XRI 7FH
       0A04 67                  MOV H,A
                       OUTPUT:
       0A05 EB                  XCHG
       0A06 2AFA41              LHLD SCPTR
       0A09 73                  MOV M,E
       0A0A 23                  INX H
       0A0B 72                  MOV M,D
       0A0C 23                  INX H
       0A0D 22FA41              SHLD SCPTR
       0A10 21E241              LXI H,D31
       0A13 1600                MVI D,0
       0A15 3AF841              LDA DCCT
       0A18 5F                  MOV E,A
       0A19 19                  DAD D
       0A1A 3C                  INR A
       0A1B 3C                  INR A
       0A1C FE05                CPI 5
       0A1E DA220A              JC LABEL2
       0A21 AF                  XRA A
                       LABEL2:
       0A22 32F841              STA DCCT
       0A25 EB                  XCHG
       0A26 1A                  LDAX D
       0A27 6F                  MOV L,A
       0A28 13                  INX D
       0A29 1A                  LDAX D
       0A2A 67                  MOV H,A
       0A2B EB                  XCHG
```

```
     0A2C 2AFC41                   LHLD TLMPTR
     0A2F 73                       MOV M,E
     0A30 23                       INX H
     0A31 72                       MOV M,D
     0A32 23                       INX H
     0A33 22FC41                   SHLD TLMPTR
     0A36 C9                       RET
                         ABS:
     0A37 47                       MOV B,A
     0A38 3E80                     MVI A,80H
     0A3A A0                       ANA B
     0A3B 57                       MOV D,A
     0A3C 78                       MOV A,B
     0A3D F0                       RP
     0A3E 2F                       CMA
     0A3F 3C                       INR A
     0A40 47                       MOV B,A
     0A41 C9                       RET
                         CHS:
     0A42 2F                       CMA
     0A43 3C                       INR A
     0A44 C9                       RET
                         PARSEP:
     0A45 2ABA41                   LHLD INTCNTR
     0A48 EB                       XCHG
     0A49 2AB441                   LHLD PDRFTM
     0A4C 7C                       MOV A,H
     0A4D BA                       CMP D
     0A4E C25807                   JNZ WAITING
     0A51 7D                       MOV A,L
     0A52 BB                       CMP E
     0A53 C25807                   JNZ WAITING
     0A56 0E02                     MVI C,2
     0A58 CDC707                   CALL SQUIB
                         FINISHUP:
                         ;
                         ;DISABLE TIMERS AND
                         ;DISPLAY INITIAL AND FINAL ORIENTATION
                         ;
     0A5B 3E1F          MVI A,1FH
     0A5D CDDB07        CALL SIM
     0A60 318F37                   LXI SP,NEED30
     0A63 119542                   LXI D,FDISP1
     0A66 0E09                     MVI C,PRINT
     0A68 CD0500                   CALL BDOS
     0A6B 218442                   LXI H,FCNT
     0A6E 3631                     MVI M,31H
                         FINLP:
     0A70 217F0A                   LXI H,ROW+1
     0A73 34                       INR M
     0A74 3E1B                     MVI A,1BH
     0A76 CD03F8                   CALL 0F803H
     0A79 3E3D                     MVI A,'='
     0A7B CD03F8                   CALL 0F803H
     0A7E 3E31          ROW:       MVI A,31H
     0A80 CD03F8                   CALL 0F803H
     0A83 3E37                     MVI A,37H
     0A85 CD03F8                   CALL 0F803H
```

```
        0A88 218442              LXI H,FCNT
        0A8B 7E                  MOV A,M
        0A8C 218742              LXI H,FDISP+2
        0A8F 77                  MOV M,A
        0A90 21E241              LXI H,D31
        0A93 FE31                CPI 31H
        0A95 CAA10A              JZ FCONT1
        0A98 23                  INX H
        0A99 23                  INX H
        0A9A FE32                CPI 32H
        0A9C CAA10A              JZ FCONT1
        0A9F 23                  INX H
        0AA0 23                  INX H
        0AA1 5E         FCONT1:  MOV E,M
        0AA2 23                  INX H
        0AA3 56                  MOV D,M
        0AA4 3E80                MVI A,80H
        0AA6 A2                  ANA D
        0AA7 3E20                MVI A,' '
        0AA9 F2B50A              JP FCONT2
        0AAC 7A                  MOV A,D
        0AAD 2F                  CMA
        0AAE 57                  MOV D,A
        0AAF 7B                  MOV A,E
        0AB0 2F                  CMA
        0AB1 5F                  MOV E,A
        0AB2 13                  INX D
        0AB3 3E2D                MVI A,'-'
                        FCONT2:
        0AB5 328B42              STA FDISP+6
        0AB8 EB                  XCHG
        0AB9 22C737              SHLD MLTP1
        0ABC 21E803              LXI H,1000
        0ABF 22C137              SHLD MLTP2
        0AC2 CD9403              CALL MULT
        0AC5 2AC137              LHLD ANSL
        0AC8 22D037              SHLD DVNDL
        0ACB 2AC337              LHLD ANSM
        0ACE 22D237              SHLD DVNDM
        0AD1 210040              LXI H,4000H
        0AD4 22D437              SHLD DVSRL
        0AD7 210000              LXI H,0
        0ADA 22D637              SHLD DVSRM
        0ADD CD7E04              CALL DIVIDE
        0AE0 2AD837              LHLD QUOTL
        0AE3 0118FC              LXI B,-1000
        0AE6 09                  DAD B
        0AE7 DA2C0B              JC ONEPT
        0AEA 3E30                MVI A,'0'
        0AEC 328C42              STA FDISP+7
        0AEF 01E803              LXI B,1000
        0AF2 09                  DAD B

        0AF3 116400     FCONT3:  LXI D,100
        0AF6 019CFF              LXI B,-100
        0AF9 3E30                MVI A,30H
        0AFB CD340B              CALL HTOA
        0AFE 328C42              STA FDISP+9
```
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```
      OB01 110A00              LXI D,10
      OB04 01F6FF              LXI B,-10
 )    OB07 3E30                MVI A,30H
      OB09 CD340B              CALL HTOA
      OBOC 328F42              STA FDISP+10
 )    OBOF 7D                  MOV A,L
      OB10 C630                ADI 30H
      OB12 329042              STA FDISP+11
 )    OB15 0E09                MVI C,9
      OB17 118542              LXI D,FDISP
      CB1A CD0500              CALL BDOS
 )    OB1D 3A8442              LDA FCNT
      OB20 3C                  INR A
      OB21 FE34                CPI 34H
 )    OB23 CA0000              JZ 0
      OB26 328442              STA FCNT
      OB29 C3700A              JMP FINLP
 )    OB2C 3E31       ONEPT:   MVI A,'1'
      OB2E 328C42              STA FDISP+7
      OB31 C3F30A              JMP FCONT3
 )    OB34 09        HTOA:     DAD B
      OB35 3C                  INR A
      OB36 DA340B              JC HTOA
 )    OB39 19                  DAD D
      OB3A 3D                  DCR A
      OB3B C9                  RET
 )               CHOICE:
      OB3C 216342              LXI H,FCBMENU
      OB3F 3600                MVI M,0
 .    CB41 01CC00              LXI B,12
      OB44 09                  DAD B
      OB45 1615                MVI D,21
 )               CHLP:
      OB47 3600                MVI M,0
      OB49 23                  INX H
 )    OB4A 15                  DCR D
      OB4B C2470B              JNZ CHLP
      OB4E 116342              LXI D,FCBMENU
 )    OB51 0E0F                MVI C,OPEN
      CB53 CD0500              CALL BDOS
      OB56 116342              LXI D,FCBMENU
 )    OB59 0E14                MVI C,READ
      OB5B CD0500              CALL BDOS
      OB5E 118000              LXI D,80H
 )    OB61 0E09                MVI C,PRINT
      OB63 CD0500              CALL BDOS
                 GETTSTN:
 )    OB66 0E01                MVI C,CONIN
      OB68 CD0500              CALL BDOS
      OB6B 320642              STA FCBRD1+6
 )    OB6E FE31                CPI 31H
      OB70 CA800B              JZ TEST1
      OB73 FE32                CPI 32H
      OB75 CAA50B              JZ TEST2
      OB78 3E04                MVI A,4
      OB7A CD03F8              CALL 0F803H
 )    OB7D C3660B              JMP GETTSTN
                 TEST1:
```

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```
        OB80 210000                    LXI H,0
        OB83 22E241                    SHLD D31
        OB86 22E641                    SHLD D33
        OB89 210040                    LXI H,4000H
        OB8C 22E441                    SHLD D32
        OB8F 3E30                      MVI A,30H
        OB91 32C742                    STA FDISP1+50
        OB94 32C942                    STA FDISP1+52
        OB97 32D442                    STA FDISP1+63
        OB9A 32DD42                    STA FDISP1+72
        OB9D 32DF42                    STA FDISP1+74
        OBA0 3C                        INR A
        OBA1 32D242                    STA FDISP1+61
        OBA4 C9                        RET
                         TEST2:
        OBA5 210000                    LXI H,0
        OBA8 22E241                    SHLD D31
        OBAB 22E441                    SHLD D32
        OBAE 210040                    LXI H,4000H
        OBB1 22E641                    SHLD D33
        OBB4 3E30                      MVI A,30H
        OBB6 32C742                    STA FDISP1+50
        OBB9 32C942                    STA FDISP1+52
        OBBC 32D242                    STA FDISP1+61
        OBBF 32D442                    STA FDISP1+63
        OBC2 32DF42                    STA FDISP1+74
        OBC5 3C                        INR A
        OBC6 32DD42                    STA FDISP1+72
        OBC9 C9                        RET
                         ;INITIALIZE SYS. CALL PRMTRS.
        001C =           ASSDRV: EQU 28
        0005 =           BDOS:   EQU 5
        0010 =           CLOSE:  EQU 16
        0001 =           CONIN:  EQU 1
        0002 =           CONOUT: EQU 2
        000B =           CONRDY: EQU 11
        0013 =           DELETE: EQU 19
        001F =           DRVIN:  EQU 31
        0020 =           DRVOUT: EQU 32
        0021 =           ERMSG:  EQU 33
        001B =           GETALO: EQU 27
        0019 =           GETCUR: EQU 25
        0007 =           GETIOB: EQU 7
        0022 =           GETVCB: EQU 34
        000D =           INIT:   EQU 13
        000A =           INLINE: EQU 10
        0005 =           LIST:   EQU 5
        0016 =           MAKE:   EQU 22
        0023 =           MOUNT:  EQU 35
        000F =           OPEN:   EQU 15
        001E =           PHYDRV: EQU 30
        0009 =           PRINT:  EQU 9
        0014 =           READ:   EQU 20
        0017 =           RENAME: EQU 23
        0011 =           SEARCH: EQU 17
        000E =           SELECT: EQU 14
        0012 =           SERCHN: EQU 18
        001A =           SETBUF: EQU 26
```

VRTSK.DEM   9/29/78

```
    0008 =              SETIOB: EQU 8
    001D =              UNMONT: EQU 29
    0015 =              WRITE:  EQU 21
                        ;END SYS.PRMTRS.
    378F =              NEED30: EQU 378FH
    3600 =              BEGYIP: EQU 3600H
    367A =              BEGPIP: EQU 367AH
    36F4 =              BEGRIP: EQU 36F4H
    4AE0 =              YRDATA: EQU 4AE0H
    4AE2 =              PRDATA: EQU 4AE2H
    4AE4 =              RRDATA: EQU 4AE4H
    37F6 =              LIJUNK: EQU 37F6H
    37CF =  .           SCRATCH:        EQU 37CFH
    001B =              ESC:    EQU 1BH
    0008 =              BS:     EQU 8
    002A =              LGT:    EQU 2AH
    37C0                        ORG 37C0H
    37C0                CNT:    DS 1
    37C1                ANSL:   DS 2
    37C1                        ORG 37C1H
    37C1                MLTP2:  DS 2
    37C3                ANSM:   DS 2
    37C5                CARYSV: DS 2
    37C7                MLTP1:  DS 2
    37C9                MSVSP:  DS 2
    37CF                        ORG 37CFH
    37CF                SIGN:   DS 1
    37D0                DVNDL:  DS 2
    37D2                DVNDM:  DS 2
    37D4                DVSRL:  DS 2
    37D6                DVSRM:  DS 2
    37D8                QUOTL:  DS 2
    37DA                QUOTM:  DS 2
    37DC                REML:   DS 2
    37DE                REMM:   DS 2
    37E2                        ORG 37E2H
    37E2                MOVPTR: DS 2
    37E4                F1MFO:  DS 2
    37E6                TMPSP:  DS 2
    37E8                STRLOC: DS 2
    37EA                STRTPT: DS 2
    37EC                ALST:   DS 2
    37EE                AMST:   DS 2
    37F0                CTR20:  DS 1
    37F1                CTR60:  DS 1
    37F2                IVAL:   DS 2
    37F4                XZERO:  DS 2
    37F6                LISVSP: DS 2
    37F8                FZERO:  DS 2
    37FA                FONE:   DS 2
    37FC          .     FOX1L:  DS 2
    37FE                FOX1M:  DS 2
    4160                        ORG 4160H
    4160 50             INBUF:  DB 80
    4161                        DS 1
    4162                        DS 80
    41B0                        ORG 41B0H
    41B0                VSINP:  DS 2
```

```
41B2                    VSPTR:   DS 2
41B4                    PDRFTM:  DS 2
41B6                    ALT:     DS 2
41B8                    SPEED:   DS 2
41BA                    INTCNTR:         DS 2
41BC                    RKTFLG:  DS 1
41BD                    TWNTYFV:         DS 2
41C6                             ORG 41C6H
41C6                    YSUM1:   DS 2
41CA                             ORG 41CAH
41CA                    PSUM1:   DS 2
41CE                             ORG 41CEH
41CE                    RSUM1:   DS 2
41D2                             ORG 41D2H
41D2                    YSUM2:   DS 2
41D6                             ORG 41D6H
41D6                    PSUM2:   DS 2
41DA                             ORG 41DAH
41DA                    RSUM2:   DS 2
41DD                             ORG 41DDH
41DD                    YAINC:   DS 1
41DE                    PCINC:   DS 1
41DF                    RLINC:   DS 1
41E2                             ORG 41E2H
41E2                    D31:     DS 2
41E4                    D32:     DS 2
41E6                    D33:     DS 2
41EA                             ORG 41EAH
41EA                    YAWR:    DS 2
41EC                    PICHR:   DS 2
41EE                    ROLLR:   DS 2
41F0                             ORG 41F0H
41F0                    QPOS:    DS 2
41F2                    QNEG:    DS 2
41F4                    SEQINDX:         DS 1
41F5                    TOGGL:   DS 1
41F6                    SAVE:    DS 2
41F8                    DCCT:    DS 2
41FA                    SCPTR:   DS 2
41FC                    TLMPTR:  DS 2
4200                             ORG 4200H
4200                    FCBRD1:  DS 1
4201 5244415441         DB 'RDATA1  DAT'
420C                             DS 21
4221                    FCBDRFTM:        DS 1
4222 445246544D         DB 'DRFTMSG TXT'
422D                             DS 21
4242                    FCBDEMO:         DS 1
4243 44454D4F44         DB 'DEMODSP TXT'
424E                             DS 21
                        FCBMENU:
4263                             DS 1
4264 4D454E554D         DB 'MENUMSG TXT'
426F                             DS 21
4284                    FCNT:    DS 1
4285 444320203DFDISP:   DB 'DC =   .    '
4292 0A0C               DB 0AH,0CH
4294 24                 DB '$'
```

```
4295 OAOAOD     FDISP1: DB OAH,OAH,ODH
4298 494E495449         DB 'INITIAL ORIENTATION'
42AB 20202020           DB '          '
42AF 46494E414C         DB 'FINAL ORIENTATION'
42CO OD                 DB ODH
42C1 444331203D         DB 'DC1 = 0.0'
42CA OAOD               DB OAH,ODH
42CC 444332203D         DB 'DC2 = 1.0'
42D5 OAOD               DB OAH,ODH
42D7 444333203D         DB 'DC3 = 0.0'
42EO 24                 DB '$'
42E1                    END 100H
```

4.2 FLOW DIAGRAMS

```
┌─────────────────────────────────────────────────────────────┐
│                                                               │
│                         INITIALIZE                            │
│                                                               │
├─────────────────────────────────────────────────────────────┤
│                                                               │
│                    UNTIL PILOT EJECTS                         │
│                   ┌───────────────────────────────────────────┤
│                   │                                           │
│                   │              WAIT                         │
│                   │                                           │
├───────────────────┴───────────────────────────────────────────┤
│                                                               │
│              PROCESS EJECTION FUNCTIONS                       │
│                                                               │
├─────────────────────────────────────────────────────────────┤
│        DISPLAY:  1. DISPLAY INITIAL ORIENTATION               │
│                  2. DISPLAY FINAL ORIENTATION                 │
└─────────────────────────────────────────────────────────────┘
```
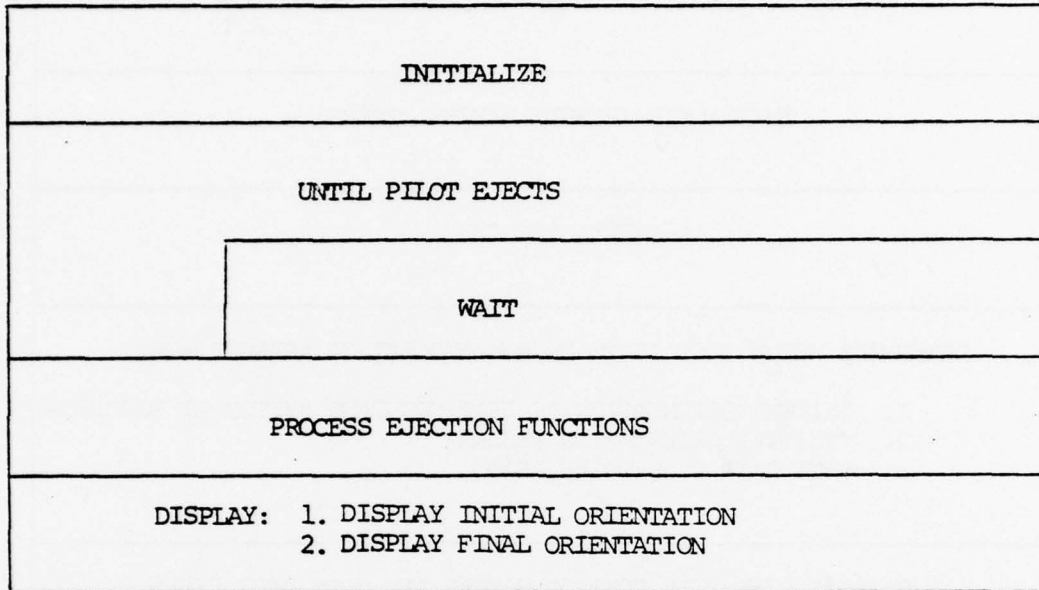
INITIALIZE:

SET UP LOCATION 3CH TO HANDLE TIMER INTERRUPTS
INITIALIZE (RESET) SYSTEM TIMERS
INITIALIZE CRT
DETERMINE WHICH TEST IS TO BE RUN AND SET UP APPROPRIATE: 1. INITIAL ORIENTATION OF SEAT/OCCUPANT SYSTEM AT EJECTION 2. 'INITIAL ORIENTATION MESSAGE' 3. RATE DATA FILE TO BE READ
INITIALIZE DISK FILE CONTROL BLOCKS AND OPEN DISK FILES
INITIALIZE PROGRAM VARIABLES
INITIALIZE RATE DATA
DETERMINE TIME OF PARACHUTE DISREEFING/SEAT/OCCUPANT SEPARATION
RE-INITIALIZE CRT
DISPLAY EJECTION FUNCTIONS ON CRT

PROCESS EJECTION FUNCTIONS

Y	TIME = T_O				N

INITIATE EJECTION

UNTIL SEAT/OCCUPANT SEPARATION

PROCESS SEQUENCER

UNTIL TIMER INTERRUPT

WAIT

$T < .3$	CASE I OF TIME			$2.05 \leq T \leq 5.05$
	$.3 \leq T < .55$	$.55 \leq T \leq 2.05$		
EXECUTE SEQUENCE A	EXECUTE SEQUENCE B	EXECUTE SEQUENCE C		EXECUTE SEQUENCE D

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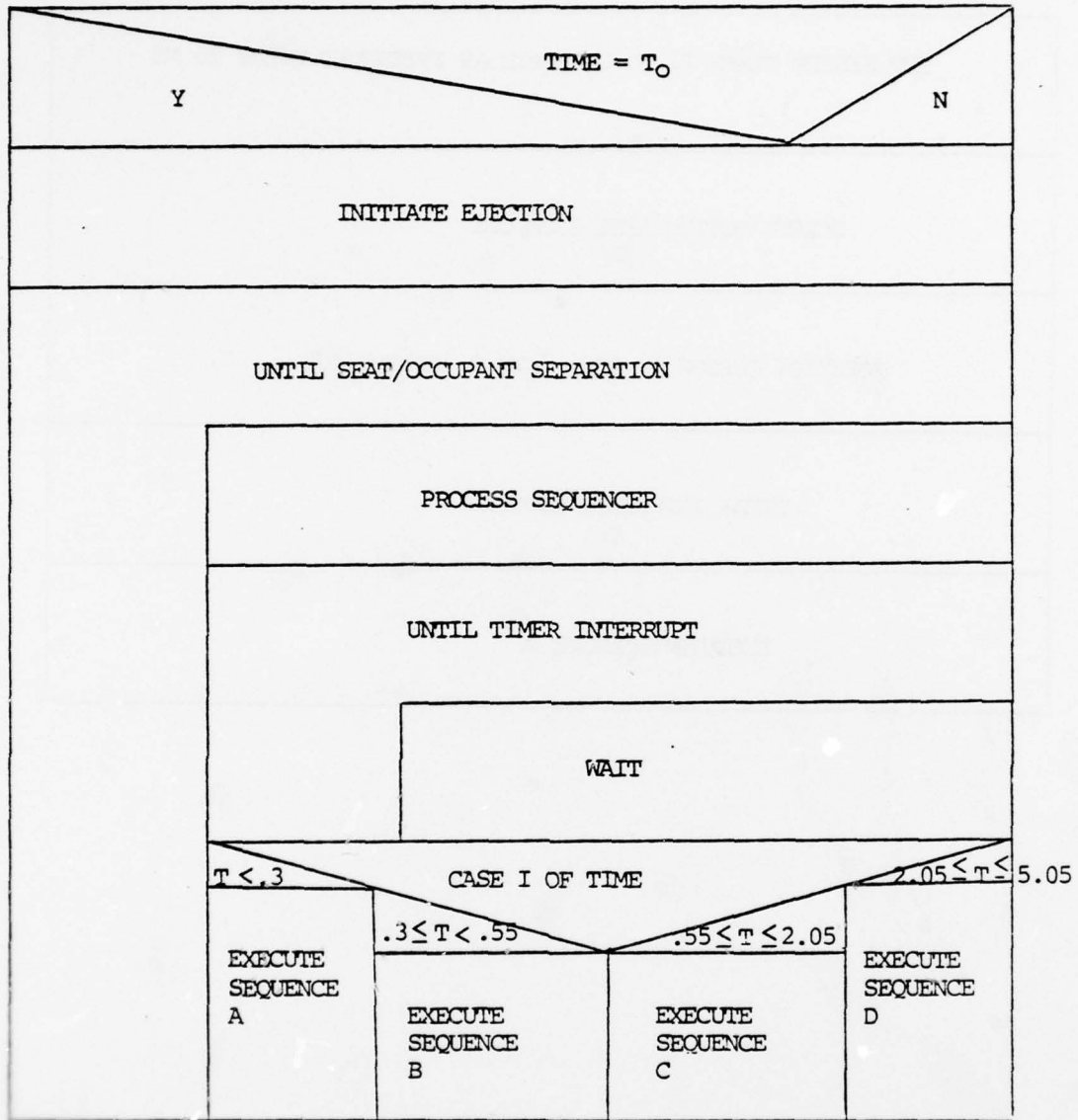
INITIATE EJECTION

SET SYSTEM TIMER T1 TO GENERATE AN INTERRUPT EVERY 25 MS
DELETE BOTTOM LINE FROM CRT
POSITION CURSOR ON CRT   (ROW 2, COLUMN 40)
CLEAR INTERRUPT COUNTER
EXECUTE SEQUENCE A

PROCESS SEQUENCER

A	CASE I OF PREVIOUS SEQUENCE EXECUTED						
CASE I OF TIME OF NEXT IN-TERRUPT		B		C			
T < .3	T = .3	CASE I OF TIME OF NEXT INTERRUPT		WAS C JUST EXECU-TED FOR 1ST TIME?			
		T < .55	T = .55	Y	N		
REPOSITION CURSOR TO ROW 2 COLUMN 40	SET SE-QUENCE PTS FOR SE-QUENCE B	REPOSITION CURSOR TO ROW 8 COLUMN 40	SET TIMER TO GENERATE INT EVERY 2.5 MS SET FLAG FOR 1ST TIME IN SEQUENCE C SET SEQUENCE POINTER FOR SEQUENCE C	CLEAR 1ST TIME FLAG SAVE # OF 25 MS IN-TERRUPTS CLEAR INT. CNTR TO BEGIN CNTNG # OF 2.5 MS INTER-RUPTS	CASE I OF TIME OF NEXT INT.		
					t < 2.05	t = 2.05	
						SET SEQ PTR. FOR SEQ D	

EXECUTE SEQUENCE A

EJCTRIN:

UNTIL 6 SQUIBS HAVE BEEN FIRED

'FIRE SQUIB' (SEND 3 CHARACTER SEQUENCE - lf, bs,* TO CRT)

EXECUTE SEQUENCE B

CTPLTRIN:

UNTIL 2 SQUIBS HAVE BEEN FIRED
'FIRE SQUIB' (SEND 3 CHARACTER SEQUENCE - lf, bs, * TO CRT)

EXECUTE SEQUENCE C
RKTSEQ:

	IS THIS THE FIRST TIME THIS ROUTINE'S BEEN CALLED?		
M			N
IGNITE ROCKET	T = 1.85?		
	M		N
	FIRE PCEM		
	INPUT RATE DATA		
INDICATE BEGINNING OF VERTICAL SEEKING MANEUVER ON CRT	INTEGRATE RATE DATA		
	UPDATE DIRECTION COSINES		
	CALCULATE ROCKET COMMANDS		
	OUTPUT GIMBALLING COMMANDS		
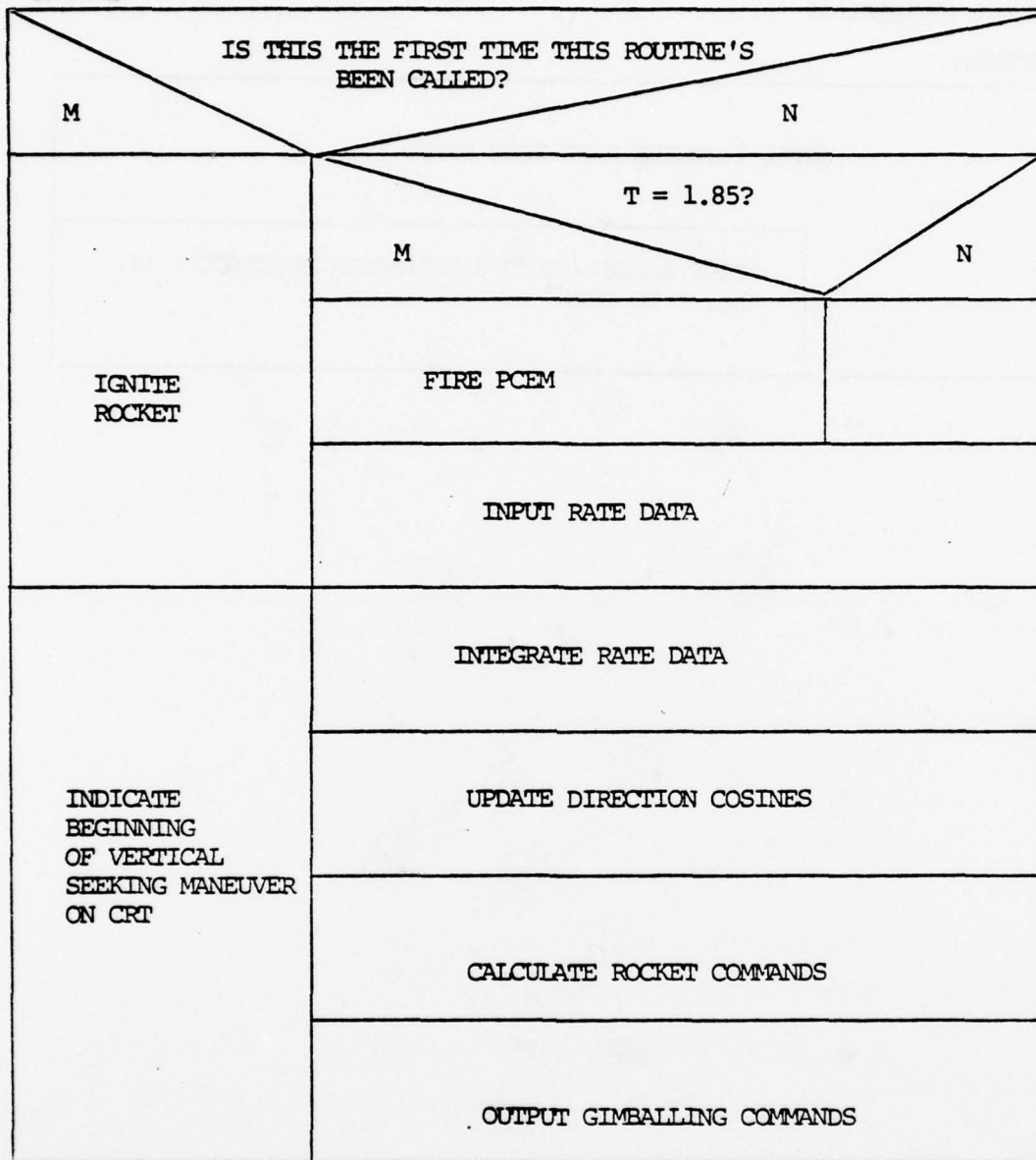
EXECUTE SEQUENCE D

PARSEP:

ELAPSED TIME T = PREDETERMINED TIME FOR SEQUENCE D EXECUTION?	
Y	N
UNTIL 2 SQUIBS HAVE BEEN FIRED	
'FIRE SQUIB' (SEND 3 CHARACTERS SEQUENCE lf, bs, *, TO CRT)	
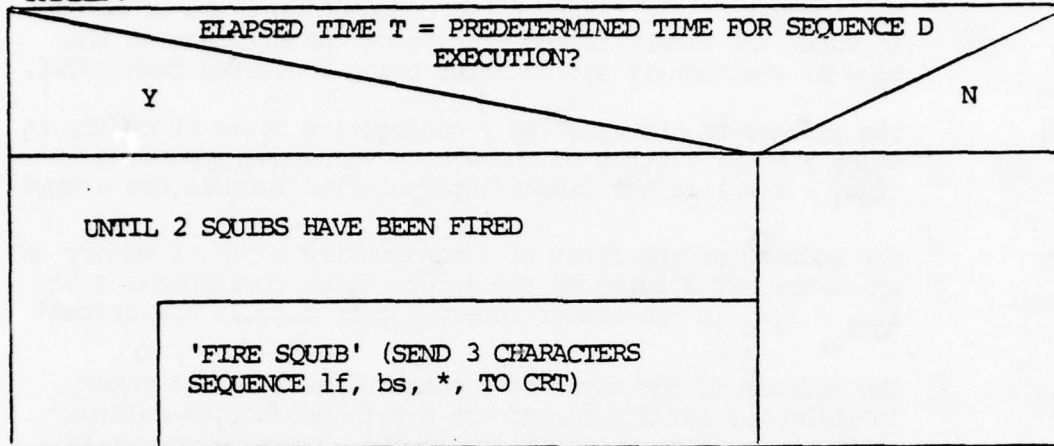
4.3   Program Variables

ALT: The address of the first of two consecutive bytes of memory in which the binary representation of the altitude at the time of ejection is stored after being converted from ASCII.

ALST: The address of the first of 2 consecutive bytes of memory in which the LST 2 bytes of the 4 byte value corresponding to $(f_o x_1 - f_1 x_o)$ in the linear interpolation formula are stored.

AMST: The address of the first of 2 consecutive bytes of memory in which the MST 2 bytes of the 4 byte value corresponding to $f_o x_1 - f_1 x_o$ in the linear interpolation formula are stored.

ANSL: The address of the first of 2 consecutive bytes of memory in which the LST 2 bytes of the 4 byte product calculated in the subroutine MULTIPLY are stored. This parameter is returned to the CALLing routine.

ANSM: The address of the first of 2 consecutive bytes of memory in which the MST 2 bytes of the 4 byte product calculated in the subroutine MULTIPLY are stored. This parameter is returned to the CALLing routine.

BS: The 8 bit code (00001000=08H) which causes the display cursor to move non-destructively to the left one position.

CARYSV: The address of the first of 2 consecutive bytes of memory used in the MULTIPLY subroutine to save the carry bits produced by adding, 'column by column', three 16 bit binary numbers. (See discussion of multiplication algorithm.)

CNT: The address of the byte of memory used to count 16 passes through the multiplication loop.

CTR20:   The address of a byte of memory used in the linear interpolation subroutine as a counter to generate 20 data points for each set of interpolating points.

CTR60:   The address of a byte of memory used as a counter to make 60 passes through the linear interpolation subroutine each time it is called. (Note: One pass generates 20 data points (including the interpolating points) X 60 passes = 1200 points generated by each CALL.)

DCCT: The address of a byte of memory used to keep track of which of the three direction cosines is to be output to the telemetry package. (One of the three is output every 2.5 ms.)

DVNDL: The address of the first of two consecutive bytes of memory containing the LST 2 bytes of the 4 byte dividend passed to the subroutine DIVIDE.

DVNDM: The address of the first of two consecutive bytes of memory containing the MST 2 bytes of the 4 byte dividend, passed to the subroutine DIVIDE.

DVSRL: The address of the first of two consecutive bytes of memory containing the LST 2 bytes of the 4 byte divisor, passed to the subroutine DIVIDE.

DVSRM: The address of the first of two consecutive bytes of memory containing the MST 2 bytes of the 4 byte divisor, which is one of the two parameters passed to the subroutine DIVIDE.

D31:   The address of the first of two consecutive bytes of memory containing the 16 bit direction cosine of the angle from the X-axis to the vertical.

D32:   The address of the first of two consecutive bytes of memory containing the 16 bit direction cosine of the angle from the Y-axis to the vertical.

D33:   The address of the first of two consecutive bytes of memory containing the 16 bit direction cosine of the angle from the Z-axis to the vertical.

ESC: The 8-bit code $(00011011 = 1B_{16})$ representing the ESCAPE character which is the first character of any ESCAPE sequence sent to the display. (These sequences provide mode control and some cursor control.)

FCBDEMO: The address of the 33 byte buffer defining the file control block for the disk file DEMOMSG.TXT, required for disk I/O under BDOS.

FCBDRFTM: The address of the 33 byte buffer defining the file control block for the disk file DRFTMSG.TXT, required for disk I/O under BDOS.

FCBMENU: The address of the 33 byte buffer defining the file control block for the disk file MENUMSG.TXT, required for disk I/O under BDOS.

FCBRD1:   The address of the 33 byte buffer defining the file control block for either the disk file RDATA1.DAT or RDATA2.DAT, required for disk I/O under BDOS.

FONE: The address of the first of two consecutive bytes of memory in which the value corresponding to f_1 in the linear interpolation formula is temporarily stored.

FZERO: The address of the first of two consecutive bytes of memory in which the value corresponding to f_0 in the linear interpolation formula is temporarily stored.

FOX1L: The address of the first of two consecutive bytes of memory in which the LST 2 bytes of the 4 byte value corresponding to $(f_0 x_1)$ in the linear interpolation formula are stored.

FOX1M: The address of the first of two consecutive bytes of memory in which the MST 2 bytes of the 4 byte value corresponding to $(f_0 x_1)$ in the linear interpolation formula are stored.

F1MF0: The address of the first of two consecutive bytes of memory in which the value corresponding to $(f_1 - f_0)$ in the linear interpolation formula is stored.

INBUF: The address of an 82 byte buffer required for CRT input under BDOS.

INCNTR: The address of the first of two consecutive bytes of memory used to count the number of timer interrupts in order to calculate elapsed time since ejection.

IVAL: The address of the first of two consecutive bytes of memory containing the value corresponding to x_i in the linear interpolation formula.

LF: The 8-bit code (00001010 = 0AH) which causes the cursor to move one line down in the same column position (LINE FEED).

LGT: The 8-bit code (00101010 = 2AH) which causes the character '*' to be displayed on the CRT.

LISVSP: The address of the first of 2 consecutive bytes of memory used to save the stack pointer at the beginning of the linear interpolation subroutine for correct return when done.

MLTP1: The address of the first of two consecutive bytes of memory in which the multiplicand (one of two parameters passed to the subroutine MULTIPLY) is stored.

MLTP2: The address of the first of two consecutive bytes of memory in which the multiplier (one of two parameters passed to the subroutine MULTIPLY) is stored.

MSVSP: The address of the first of two consecutive bytes of memory used to save the stack pointer at the beginning of the MULTIPLY subroutine for correct return when done.

MOVPTR: The address of the first of two consecutive bytes of memory used as a pointer to move each record of the rate data file into the proper area of memory as it is read from the disk.

NEED30:   The address of the first of thirty consecutive bytes of memory to which the stack pointer must be set before CALLing the subroutine in the VIOROM (at memory location F803) which displays the character in the accumulator).

PCINC: The address of the byte of memory used as a flag to control $\Delta\Theta y$ in implementing the Crowder Hession Update Algorithm. Its value is determined by pitch rate data.

PDRFTM: The address of the first of two consecutive bytes of memory in which the calculated parachute disreefing item is stored.

PICHR: The address of the first of two consecutive bytes of memory used to save the sum required in order to use the trapezoid rule to integrate pitch rate data (see detailed discussion of trapezoidal rule).

PSUM1:   The address of the first of two consecutive bytes of memory used in the implementation of the trapezoid rule, which contain, at any given time during the vertical seeking maneuver, the partial sum of pitch rate data whose value at time t is defined as:

at t=2.5 $PSUM1=(0+q_{t-1.25})$

at t=5.0, 7.5...1500 $PSUM-(q_{t-3.75}+q_{t-1.25})$

(where t = number of elapsed milliseconds since the beginning of the vertical seeking maneuver).

PSUM2:   The address of the first of two consecutive bytes of memory used in basically the same way as PSUM1, whose value at time t is defined as:

at t=2.5 $PSUM2=(0+q_t)$

at t=5.0, 7.5...1500 $PSUM2=(q_{t-2.5}+q_{t-1.25})$

QNEG: The address of the first of two consecutive bytes of memory containing the binary value corresponding to the quantity in the trapezoidal rule (see detailed discussion).

$-(2A/\Delta h) = -0CCO_H = F340_H$

OPOS: The address of the first of two consecutive bytes of memory
           containing the binary value corresponding to the quantity in
           the trapezoidal rule (see detailed discussion).

$$2A/\Delta h = OCCO_H$$

QUOTL: The address of the first of two consecutive bytes of memory
           containing the LST 2 bytes of the 4 byte quotient calculated
           in the subroutine DIVIDE. This parameter is passed to the
           CALLing routine.

QUOTM: The address of the first of two consecutive bytes of memory
           containing the MST 2 bytes of the 4 byte quotient calculated
           in the subroutine DIVIDE. This parameter is passed to the
           CALLing routine.

REML: The address of the first of two consectuive bytes of memory
           used in the subroutine DIVIDE for temporary storage of the
           LST 2 bytes of the 4 byte dividend, updated with each pass
           through the divide loop.

REMM: The address of the first of two consecutive bytes of memory
           used in the subroutine DIVIDE for temporarily storing the
           MST 2 bytes of the 4 byte dividend updated with each pass
           through the divide loop.

RKTFLG: The address of a byte of memory used as a flag word to indicate
           when sequence C is being executed for the first time.

RLINC: The address of the byte of memory used as a flag to control
           $\Delta\Theta x$ in implementing the Crowder Hession Direction Cosine
           Update Algorithm. Its value is determined by roll rate data.

ROLLR: The address of the first of two consecutive bytes of memory
           used to save the sum required in order to use the trapezoid
           rule to integrate roll rate data. (See detailed discussion
           of trapezoid rule.)

RSUM1:   The address of the first of two consecutive bytes of memory
           used in the implementation of the trapezoid rule, which
           contain, at a given time during the vertical seeking maneuver
           the partial sum of roll rate data whose value at time t is
           defined as:

at t=2.5 $RSUM1 = (0 + p_{t-1.25})$

at t=5.0, 7.5,...1500 $RSUM1 = (p_{t-3.75} + p_{t-1.25})$

where t = number of elapsed milliseconds since the beginning
of the vertical seeking maneuver).

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RSUM2:   The address of the first of two consecutive bytes of memory used in basically the same way as RSUM1, whose value at time t is defined as:

$$at\ t = 2.5 \qquad RSUM2 = (0 + p_t)$$

$$at\ t = 5.0,\ 7.5...1500 \qquad RSUM2 = (p_{t-2.5} + p_t)$$

SAVE: The address of the first of two consecutive bytes of memory used to save the stack pointer at the beginning of the cosine update subroutine for correct return when done.

SCPTR: The address of the first of two consecutive bytes of memory used as a pointer to the block of memory (locations 3800_H to $3CAF_H$) in which the rocket gimballing commands are stored.

SCRATCH: The address of the first of two consecutive bytes of memory used to save the return address for correct return from the MULTIPLY subroutine when CALLed by the linear interpolation subroutine (LINT).

SEQINDX: The address of the byte of memory which determines to which of 4 sequences control of the program is passed.

SIGN: The address of the byte of memory used to keep track of the correct sign of the product calculated in the MULTIPLY subroutine or of the quotient calculated by the DIVIDE subroutine.

SPEED: The address of the first of two consecutive bytes of memory in which the hexadecimal representation of the speed of the pilot at ejection is stored.

STRLOC: The address of the first of two consecutive bytes of memory passed as a parameter to the linear interpolation subroutine which designates the beginning of one of three blocks of memory in which interpolated rate data is to be stored.

STRTPT: The address of the first of two consecutive bytes of memory passed as a parameter to the linear interpolation subroutine which designates the beginning of one of three blocks of memory containing 60 interpolating points.

TLMPTR: The address of the first of two consecutive bytes of memory designating where within a block of memory (locations 3CB0H to 414FH) telemetry output data is to be stored.

TMPSP: The address of the first of two consecutive bytes of memory used to save the contents of the stack pointer before CALLing the subroutine MULTIPLY.

TOGGL: The address of a byte of memory used to keep track of which of the two passes through the cosine update routine that take place every 2.5 ms., the current pass is.

TWNTYFV: The address of the first of two consecutive bytes of memory used to save the number of 25 ms interrupts received.

VSINP: The address of the first of two consecutive bytes of memory used as a pointer within a 12 byte block of rate data.

VSPTR: The address of the first of two consecutive bytes of memory used as a pointer within the block of memory containing all of the rate data for the current vertical seeking maneuver to designate the 12 bytes of rate data which will be input with the next timer interrupts.

XZERO: The address of the first of two consecutive bytes of memory in which the value corresponding to x_o in the linear interpolation formula is temporarily stored.

YAINC: The address of the byte of memory used as a flag to control $\Delta\Theta z$ in implementing the Crowder-Hession Cosine Update Algorithm. Its value is determined by yaw rate data.

YAWR: The address of the first of two consecutive bytes of memory used to save the sum required in order to use the trapezoidal rule to integrate yaw rate data. (See detailed discussion of trapezoidal rule).

YSUM1:   The address of the first of two consecutive bytes of memory used in the implementation of the trapezoid rule, which contain, at any given time during the vertical seeking maneuver, the partial sum of yaw rate data and whose value at time t is defined as:

$$\text{at } t=2.5 \qquad\qquad \text{YSUM1}=(0+r_{t-1.25})$$

$$\text{at } t=5.0,\ 7.5\ldots1500 \qquad \text{YSUM1}=(r_{t-3.75}+tr_{t-1-25})$$

(where t = number of elapsed milliseconds since the beginning of the vertical seeking maneuver.)

YSUM2:   The address of the first of two consecutive bytes of memory used in basically the same way as YSUM1, whose value at time t is defined as:

$$\text{at } t=2.5 \qquad\qquad \text{PSUM2}=(0+r_t)$$

$$\text{at } t=5.0,\ 7.5\ldots1500 \qquad \text{PSUM2}=(r_{t-2.5}+r_t)$$

4.4   Memory Map of Data Buffers and Program Variables

	3600	3610	3620	3630	3640	3650	3660	3670	3680	3690	36A0	36B0	36C0	36D0	36E0	36F0
00	(Γ_0)	(Γ_{160})	(Γ_{320})	(Γ_{480})	(Γ_{640})	(Γ_{800})	(Γ_{960})	(Γ_{1120})	(g_{60})	(g_{220})	(g_{380})	(g_{540})	(g_{700})	(g_{860})	(g_{1020})	(g_{1180})
02	(Γ_{20})	(Γ_{180})	(Γ_{340})	(Γ_{500})	(Γ_{660})	(Γ_{820})	(Γ_{980})	(Γ_{1140})	(g_{80})	(g_{240})	(g_{400})	(g_{560})	(g_{720})	(g_{880})	(g_{1040})	(g_{1200})
04	(Γ_{40})	(Γ_{200})	(Γ_{360})	(Γ_{520})	(Γ_{680})	(Γ_{840})	(Γ_{1000})	(Γ_{1160})	(g_{100})	(g_{260})	(g_{420})	(g_{580})	(g_{740})	(g_{900})	(g_{1060})	(ρ_0)
06	(Γ_{60})	(Γ_{220})	(Γ_{380})	(Γ_{540})	(Γ_{700})	(Γ_{860})	(Γ_{1020})	(Γ_{1180})	(g_{120})	(g_{280})	(g_{440})	(g_{600})	(g_{760})	(g_{920})	(g_{1080})	(ρ_{20})
08	(Γ_{80})	(Γ_{240})	(Γ_{400})	(Γ_{560})	(Γ_{720})	(Γ_{880})	(Γ_{1040})	(Γ_{1200})	(g_{140})	(g_{300})	(g_{460})	(g_{620})	(g_{780})	(g_{940})	(g_{1100})	(ρ_{40})
0A	(Γ_{100})	(Γ_{260})	(Γ_{420})	(Γ_{580})	(Γ_{740})	(Γ_{900})	(Γ_{1060})	(g_0)	(g_{160})	(g_{320})	(g_{480})	(g_{640})	(g_{800})	(g_{960})	(g_{1120})	(ρ_{60})
0C	(Γ_{120})	(Γ_{280})	(Γ_{440})	(Γ_{600})	(Γ_{760})	(Γ_{920})	(Γ_{1080})	(g_{20})	(g_{180})	(g_{340})	(g_{500})	(g_{660})	(g_{820})	(g_{980})	(g_{1140})	(ρ_{80})
0E	(Γ_{140})	(Γ_{300})	(Γ_{460})	(Γ_{620})	(Γ_{780})	(Γ_{940})	(Γ_{1100})	(g_{40})	(g_{200})	(g_{360})	(g_{520})	(g_{680})	(g_{840})	(g_{1000})	(g_{1160})	(ρ_{100})

	3700	3710	3720	3730	3740	3750	3760	3770	3780	3790	37A0	37B0	37C0	37D0	37E0	37F0
00	(P120)	(P280)	(P440)	(P600)	(P760)	(P920)	(P1080)						CNT	DVND L		
01	(P140)	(P300)	(P460)	(P620)	(P780)	(P940)	(P1100)						ANSL	DVND M	MOVER TR	CNTR20
02	(P160)	(P320)	(P480)	(P640)	(P800)	(P960)	(P1120)						MLTP2	DVSR L	FIMFO	CNTRL0
03	(P180)	(P340)	(P500)	(P660)	(P820)	(P980)	(P1140)						ANSM	DVSR M	LMPSP	IVAL
04	(P200)	(P360)	(P520)	(P680)	(P840)	(P1000)	(P1160)						CARY2V	QUOT L	STRVOC	XZERO
05	(P220)	(P380)	(P540)	(P700)	(P860)	(P1020)	(P1180)						MLTP1	QUOT M	STRTPT	LISUSP
06	(P240)	(P400)	(P560)	(P720)	(P880)	(P1040)	(P1200)						MSUSP	REM L	ALST	FZERO
07	(P260)	(P420)	(P580)	(P740)	(P900)	(P1060)								REM M	AMST	FONE
08																FOXIL
09																FOXIM
0A																
0B																
0C																
0D																
0E																
0F											NEED30		SIGN			

	3800	3810	3820	3830	3840	3850	3860	3870	3880	3890	38A0	38B0	38C0	38D0	38E0	38F0
00	(SC_1)	(SC_9)	(SC_{17})	(SC_{25})	(SC_{33})	(SC_{41})	(SC_{49})	(SC_{57})	(SC_{65})	(SC_{73})	(SC_{81})	(SC_{89})	(SC_{97})	(SC_{105})	(SC_{113})	(SC_{121})
01																
02	(SC_2)															
03																
04	(SC_3)															
05																
06	(SC_4)															
07																
08	(SC_5)															
09																
0A	(SC_6)															
0B																
0C	(SC_7)															
0D																
0E	(SC_8)	(SC_{16})	(SC_{24})	(SC_{32})	(SC_{40})	(SC_{48})	(SC_{56})	(SC_{64})	(SC_{72})	(SC_{80})	(SC_{88})	(SC_{96})	(SC_{104})	(SC_{112})	(SC_{120})	(SC_{128})
0F																

	3C00	3C10	3C20	3C30	3C40	3C50	3C60	3C70	3C80	3C90	3CA0	3CB0	3CC0	3CD0	3CE0	3CF0
00	(SC_{513})	(SC_{521})	(SC_{529})	(SC_{531})	(SC_{545})	(SC_{583})	(SC_{561})	(SC_{569})	(SC_{577})	(SC_{585})	(SC_{593})	(TEL_{1})	(TEL_{9})	(TEL_{17})	(TEL_{25})	(TEL_{33})
01																
02											(SC_{594})	(TEL_{2})				
03																
04											(SC_{595})	(TEL_{3})				
05																
06											(SC_{596})	(TEL_{4})				
07																
08											(SC_{597})	(TEL_{5})				
09																
0A											(SC_{598})	(TEL_{6})				
0B																
0C											(SC_{599})	(TEL_{7})				
0D																
0E	(SC_{620})	(SC_{628})	(SC_{534})	(SC_{544})	(SC_{632})	(SC_{510})	(SC_{508})	(SC_{574})	(SC_{584})	(SC_{592})	(SC_{600})	(TEL_{8})	(TEL_{16})	(TEL_{24})	(TEL_{32})	(TEL_{40})
0F																

	41F0	41E0	41D0	41C0	41B0	41A0	4190	4180	4170	4160	415D	4140	4130	4120	4110	4100
00	QPOS		(previous yaw value 2)		VS1NP											
01												(Tel. 583)	(Tel. 593)	(Tel. 591)	(Tel. 581)	(Tel. 553)
02	QNEG	D31	YSUM2		VSEPTR							(Tel. 594)				
03																
04	SEQINDX	D32	(previous pitch value 2)	(previous yaw value 1)	PDRFTM							(Tel. 595)				
05	TOGGL															
06	SAVE	D33	PSUM2	YSUM1	AVT							(Tel. 596)				
07																
08	DCCT		(previous roll value 2)	(previous pitch value 1)	SPEED							(Tel. 597)				
09																
0A	SCPTR	YAWR	RSUM2	PSUM1	INTCNTK							(Tel. 598)				
0B																
0C	TLMPTR	PICHR	YAINC	(previous roll value 1)	RKTFLG							(Tel. 599)				
0D			PINC													
0E		ROLLR	RLINC	RSUM1	TWNTYFV							(Tel. 600)	(Tel. 592)	(Tel. 584)	(Tel. 582)	(Tel. 580)
0F																

	42F0	42E0	42D0	42C0	42B0	42A0	4290	4280	4270	4260	4250	4240	4230	4220	4210	4200
00		(b)	(=)	(carriage ret)	(H)	(O)	(b)							.		FCBRD1
01			(b)	(D)	(N)	(R)	(b)					.		FCBDRPT		(R)
02			(.)	(C)	(A)	(H)	(line feed)	FCNT		FCBMENU		FCBDEIX		(A)		(D)
03				(1)	(L)	(E)	(carriage ret)	FDISP (D)		(m)		(D)		(R)		(A)
04			(line feed)	(b)	(b)	(N)	($)	(c)		(E)		(E)		(F)		(T)
05			(carriage ret)	(=)	(O)	(T)	(line feed)	(b)		(N)		(m)		(T)		(A)
06			(D)	(b)	(R)	(A)	(line feed)	(b)		(N)		(O)		(MK)		(1 o 2)
07			(C)		(H)	(T)	(carriage ret)	(b)		(U)		(A)		(S)		(b)
08			(3)	(.)	(E)	(H)	(I)	=		(m)		(S)		(G)		(b)
09			(b)	(line feed)	(N)	(O)	(N)	(b)		(S)		(P)		(b)		(A)
0A			(=)	(carriage ret)	(T)	(N)	(H)	(b)		(G)		(b)		(T)		(A)
0B			(b)	(D)	(A)	(b)	(T)	(b)		(b)		(T)		(X)		(T)
0C			(.)	(C)	(T)	(b)	(H)	(.)		(T)		(X)		(T)		
0D				(2)	(T)	(b)	(A)	(b)		(X)		(T)				
0E				(t)	(O)	(b)	(L)	(b)		(T)						
0F					(N)	(F)	(b)	(b)								

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	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
4AF0		(P_3)		(r_4)		(g_7)		(P_4)		(r_5)		(g_6)		(P_5)		(r_7)
4AE0		(r_1)		(g_1)		(P_1)		(r_2)		(g_2)		(P_2)		(r_3)		(g_3)
4AD0																
4AC0																
4AB0																
4AA0																
4A90																
4A80																
4A70																
4A60																
4A50																
4A40																
4A30																
4A20																
4A10																
4A00																

5.   USER'S GUIDE

5.1   Objective

The objective of the program DEMO is to demonstrate, on the IMSAI PCS 80/30 software development system, the capability of the INTEL 8085 μP to perform the real-time timing and sequencing required to execute the functions of a vertical seeking ejection seat. A listing of the program can be found in section 4.1.

5.2   Approach/Assumptions

Because of its nature as a software development system, the IMSAI PCS 80/30 lacks the specialized hardware interfaces and "peripheral devices" that would be found on a true ejection seat system. To compensate for this, the program goes through a lengthy initialization process before the demonstration of the real-time timing, sequencing and simulated execution of the ejection functions takes place. The program is capable of simulating an ejection from an initial orientation of a 90° roll or a 180° roll.

5.3   Input

Below is a list of the input files and parameters required by the program. The files are permanently stored on the disk and read as required during execution of the program; the parameters are input by the user as described in section 5.5. A brief description of each is given here.

5.3.1   DISK FILES

5.3.1.1   MENUMSG.TXT

This file contains the message displayed on the CRT, giving the user a choice of executing the ejection from an initial orientation of a 90° roll or a 180° roll. The message is shown in section 5.5-1.

5.3.1.2   RDATA1.DAT or RDATA2.DAT

These files contain the rate data interpolating points for the 90° roll test and the 180° roll test respectively. When the user selects the initial orientation, the appropriate RDATA file is read into memory. Using the information contained in the file, the 3600 pieces of rate data required to execute the vertical seeking maneuver are generated and stored in memory locations 4AE04-66FFH.

5.3.1.3   DRFTMSG.TXT

This file contains the messages displayed on the CRT asking the user to input the altitude and speed at ejection. The messages are shown in sections 5.5-2 and 5.5-3 respectively.

5.3.1.4 DEMODSP.TXT

This file contains a list of all of the ejection functions to be executed along with instructions on how to begin the demonstration. The message is shown in section 5.5-5.

5.3.2   Keyboard Input

5.3.2.1 Test Number

The user selects the initial orientation of the ejection seat system. TEST 1 executes the ejection from an initial orientation of a 90° roll; TEST 2 executes the ejection from an initial orientation of a 180° roll.

5.3.2.2 Initial Altitude and Speed

These two parameters determine the time at which the functions PARACHUTE DISREEFING and SEAT/OCCUPANT SEPARATION are executed as defined in Figure 2.12.

5.3.2.3 Ejection Signal

When all of the initialization functions have been completed, the program waits for the character 'E' to be input. This initiates the execution of the ejection sequence.

5.4   Output

To indicate the execution of each of the ejection functions, the program displays the character '*' next to the function being performed. When all of the ejection functions have been executed, the program displays the direction cosines of the initial orientation of the ejection seat system and its orientation at the completion of the vertical seeking maneuver. Using these, the position of the ejection seat system can be determined. (See Figure 2.2). The final CRT displays for the 90° roll test and the 180° roll test are shown in Figure 5.1(a) and 5.1(b) respectively.

5.5   Program Set Up/Run Procedure

After loading the diskette entitled "VRTSK", the program can be run as follows:

1. Type "DEMO" as an IMDOS resident console command

    The program will clear the screen and display the message

    SELECT DESIRED TEST

    1. 90 DEGREE ROLL
    2. 180 DEGREE ROLL

```
┌─────────────────────────────────────────────────────┐
│                                                       │
│        uP EJECTION SEAT FEASIBILITY DEMO              │
│                                                       │
│    Emergency 02 Generation                            │
│    Inertial Reel Firing                               │
│    Neck Bladder Inflation                             │
│    Hip Thruster Firing                                │
│    Canopy Removal                                     │
│    Gyro Spinup                                        │
│    Seat Release                                       │
│    Catapult Initiation                                │
│    Rocket Initiation                                  │
│    Rocket Gimballing Initiated                        │
│    PCEM Fired                                         │
│    Rocket Gimballing Completed                        │
│    Parachute Disreefed                                │
│    Seat/Occupant Separated                            │
│    ***************************************            │
│    Initial Orientation       Final Orientation        │
│    D31 = 0.000               D31 = -.184              │
│    D32 = 1.000               D32 =  .004              │
│    D33 = 0.000               D33 = -.969              │
│                                                       │
└─────────────────────────────────────────────────────┘
```

(a)

```
┌─────────────────────────────────────────────────────┐
│                                                       │
│        uP EJECTION SEAT FEASIBILITY DEMO              │
│                                                       │
│    Emergency 02 Generation                            │
│    Inertial Reel Firing                               │
│    Neck Bladder Inflation                             │
│    Hip Thruster Firing                                │
│    Canopy Removal                                     │
│    Gyro Spinup                                        │
│    Seat Release                                       │
│    Catapult Initiation                                │
│    Rocket Initiation                                  │
│    Rocket Gimballing Initiated                        │
│    PCEM Fired                                         │
│    Rocket Gimballing Completed                        │
│    Parachute Disreefed                                │
│    Seat/Occupant Separated                            │
│    ***************************************            │
│    Initial Orientation       Final Orientation        │
│    D31 = 0.000               D31 =  .164              │
│    D32 = 0.000               D32 =  .089              │
│    D33 = 1.000               D33 = -.970              │
│                                                       │
└─────────────────────────────────────────────────────┘
```

(b)

5.1 Final CRT Displays

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2. Type "1" or "2"

> Entering an invalid test number causes the
> "SELECT DESIRED TEST" message to be reissued.
> When a valid entry is made, the program will
> initialize the rate data for the test select-
> ed.   (This takes 1.5-2.0 minutes).   When the
> rate data initialization is complete, the
> program will display the message
>
> ENTER ALTITUDE AT EJECTION (0-18,000 ft.)

3. Type a valid response and hit carriage return

> Entering an invalid altitude causes the
> "ENTER ALTITUDE" message to be reissued.
> When a valid entry is made, the program
> will display the message
>
> ENTER SPEED AT EJECTION (0-600 KEAS)

4. Type a valid response and hit carriage return

> Entering an invalid speed causes the
> "ENTER SPEED" message to be reissued.
> When a valid entry is made, the follow-
> ing display will appear on the CRT

```
                μP EJECTION SEAT FEASIBILITY DEMO

        Emergency 02 Generation
        Inertial Reel Firing
        Neck Bladder Inflation
        Hip Thruster Firing
        Canopy Removal
        Gyro Spinup
        Seat Release
        Catapult Initiation
        Rocket Initiation
        Rocket Gimballing Initiated
        PCEM Fired
        Rocket Gimballing Completed
        Parachute Disreefed
        Seat/Occupant Separated
        **********************************************

        TO BEGIN DEMONSTRATION, PRESS'E'
```

5. Type "E"

>The program is now demonstrating, in real-time, the timing, sequencing and simulated execution of the ejection functions. The demonstration takes either 2.05 or 5.05 seconds to run, depending on the time of PARACHUTE DISREEFING/ SEAT/OCCUPANT SEPARATION.

5.6 Special Features

Some modifications were made to the program to create a second version (PRNTOUT). PRNTOUT performs the same functions as DEMO (though not in real time), but also provides hardcopy output tracing each step in the execution of the vertical seeking maneuver.

PRNTOUT outputs the following data:

T   - time (in milliseconds) since the beginning of the vertical seeking maneuver.

R   - yaw rate data (in deg./sec.) input at time T

Q   - pitch rate data (in deg./sec.) input at time T

P   - roll rate data (in deg./sec.) input at time T

DC1   - direction cosine of the angle from the x-axis to the vertical after being updated at time T

DC2   - direction cosine of the angle from the Y-axis to the vertical after being updated at time T

DC3   - direction cosine of the angle from the z-axis to the vertical after being updated at time T

RLCMND - the roll steering command generated at time T

PCCMND - the pitch steering command generated at time T

Appendix A contains a program listing of PRNTOUT along with the data output for the 90° roll test and the 180° roll test.

After loading the diskette entitled "VRTSK", PRNTOUT can be run as follows:

1. Type "PRNTOUT" as an IMDOS resident console command

>The program will clear the screen and display the message

>SELECT DESIRED TEST

      1. 90 DEGREE ROLL
      2. 180 DEGREE ROLL

2. Type "1" or "2"

Entering an invalid test number causes the
"SELECT DESIRED TEST" message to be reissued.
When a valid entry is made, the program will
initialize the rate data for the test select-
ed. (This takes 1.5-2.0 minutes). When the
rate data initialization is complete, the
program will display the message

ENTER ALTITUDE AT EJECTION (0-18,000 ft.)

3. Type a valid response and hit carriage return

Entering an invalid altitude causes the
"ENTER ALTITUDE" message to be reissued.
When a valid entry is made, the program
will display the message

ENTER SPEED AT EJECTION (0-600 KEAS)

4. Type a valid response and hit carriage return

Entering an invalid speed causes the
"ENTER SPEED" message to be reissued.
When a valid entry is made, the follow-
ing display will appear on the CRT

```
        μP EJECTION SEAT FEASIBILITY DEMO

Emergency 02 Generation
Inertial Reel Firing
Neck Bladder Inflation
Hip Thruster Firing
Canopy Removal
Gyro Spinup
Seat Release
Catapult Initiation
Rocket Initiation
Rocket Gimballing Initiated
PCEM Fired
Rocket Gimballing Completed
Parachute Disreefed
Seat/Occupant Separated
*********************************************

TO BEGIN DEMONSTRATION, PRESS 'E'
```

5. Type "E"

> The program is now executing the ejection
> functions, printing the data described above
> as each step in the vertical seeking algorithm
> is completed. Running PRNTOUT takes approxi-
> mately 50 minutes.

5.7 Outline of Changes for Implementation in an Actual Ejection
Seat System

As previously mentioned, the demonstration program was written for
implementation on a software development system; some changes are
required if it is to be implemented in an actual ejection seat system.
These changes are outlined below. (Refer to the program listing in
section 4.1).

a) Delete the following lines:

```
108
10B
111
117
11D
120
132 - 19B
1DF - 1EE
1FE - 393
59D - 628
6B7 - 745
77F - 7AE
7C7 - 7E1
802 - 813
82B - 83C
842 - 847
874 - 877
A5B - BC9
```

If no multiplication or division is required

```
394 - 59C
```

b) Delete the initialization of the following variables
(end of listing).

ASSDRV	INIT	SETIOB	F1MF0	F0X1M
BDOS	INLINE	UNMOUNT	TMPSP	INBUF
CLOSE	LIST	WRITE	STRLOC	VSINP
CONIN	MAKE	BEGYIP	STRTPT	VSPTR
CONOUT	MOUNT	BEGPIP	ALST	TWNTYFV

CONRDY	OPEN	BEGRIP	AMST	SCPTR
DELETE	PHYDRV	YRDATA	CTR20	TLMPTR
DRVIN	PRINT	PRDATA	CTR60	FCBRD1
DRVOUT	READ	RRDATA	IVAL	FCBDRFTM
ERMSG	RENAME	LIJUNK	XZERO	RCBDEMO
GETALO	SEARCH	ESC	LISVSP	FCBMENV
GETCUR	SELECT	BS	FZERO	FCNT
GETIOB	SERCHN	LGT	FONE	FDISP
GETVCB	SETBUF	MOVPTR	FOX1L	FDISP1

c) Change line 10E to CALL INZDCS, where INZDCS is a sub-routine which inputs the direction cosines of the initial orientation of the ejection seat system, converts them to the scaling used in the program (see section 2.1.4.1), and stores them in D31, D32 and D33. (Note: This may be part of the routine EJECT, that is, input at the time of ejection).

d) The subroutine INZRST75 (lines 126-131) may have to be changed if the 2.5 ms interrupt received by the system directs the program counter to a location other than 3C.

e) If the time of parachute disreefing and seat/occupant separation is determined only by the altitude and speed of the ejection seat system at ejection, these two values (ALT and SPEED) should be input with the initial orientation values D31, D32 and D33. Their time of execution should be stored in PARDRFTM (in terms of 2.5 ms interrupts). If the conversion from altitude and speed to time is determined as defined by Figure 2.12, the code from lines 62B-6BC and A45-A53 can be used. (This requires that the MULT and DIVIDE subroutines be left in) Figure 2.12, as implemented in the code, is represented by the follow-ing equations: (If a similar, but different, para-chute deployment chart is used, the changes can be made as noted.)

1. if ALT $\geq$ 14000 ft, T = 4.5   (test in line 62E)
2. if ALT < 6000 ft, T = 1.5   (test in line 638)
3. if SPEED < 240 KEAS, T = 1.5   (test in line 642)
4. if ALT $\geq$ 'a', T = 4.5   (test in line 6A5)
5. if ALT < 'a', T = 1.5   (test in line 6A5)

where 'a' is the altitude on the diagonal, corresponding to the given speed. 'a' is computed using the equation of the diagonal as follows

$$F(x_i) = a = \frac{(f_o x_1 - f_1 x_o) + ((f_1 - f_o)(x_i))}{(x_1 - x_o)}$$

$$a = \frac{(14000)(600)-(6000)(240)+((6000-14000)(SPEED))}{(600-240)}$$

This is implemented in the code (lines 649-6A1) as:

$$a = 19333 - 22.2(SPEED)$$

If an entirely different method of determining the time of parachute disreefing/seat/occupant separation is used, the code from lines 62B-6BC and A45-A53 should be deleted, and code implemented to determine the time as defined.

f) For the first .55 seconds after ejection, the interrupt counter is counting 25 ms interrupts; after that, it is counting 2.5 ms interrupts. Two separate rates were used to allow time during the first .55 seconds to interface with the display. In an actual system, the interrupt rate would most likely be constant (2.5 ms or whatever is to be used). Since the time of execution of the functions is determined by counting the number of interrupts, the comparison values used would have to be changed. Each of these comparison values is noted below.

line 6A9, 6B0 - Set time of parachute disreefing/seat/ occupant separation (=number of 2.5 ms interrupts since beginning of vertical seeking maneuver)

line 7FB - Test if time to start sequence B (next interrupt = 12th 25 ms interrupt?)

line 824 - Test if time to start sequence C (next interrupt = 21st 25 ms interrupt?)

line 860 - Test if end of vertical seeking maneuver (last interrupt = 600th 2.5 ms interrupt?)

line 89A - Test if time to execute Fire PCEM (520th 2.5 ms interrupt?)

g) The routine EJKEY (lines 746-755) would have to be changed to input the ejection signal as defined by the system.

h) The routine INRATDTA (lines 8A9-8DD) inputs the six pieces of rate data required every 2.5 ms. In the demonstration program, this data is read from a memory buffer; in an actual system it would be read through an I/O port as defined by the hardware designed to interface with the gyros.

This routine also performs part of the integration as follows:

1. read $r_{t-1.25}$

   save it - (replaces $r_{t=3.75}$)

   calculate YSUM1 (see section 4.3)

2. read $q_{t-1.25}$

   save it - (replaces $q_{t-3.75}$)

   calculate PSUM1 (see section 4.3)

3. read $p_{t-1.25}$

   save it - (replaces $p_{t-3.75}$)

   calculate RSUM1 (see section 4.3)

4. read r_t

   save it - (replaces $r_{t-2.5}$)

   calculate YSUM2 (see section 4.3)

5. read q_t

   save it - (replaces $q_{t-2.5}$)

   calculate PSUM2 (see section 4.3)

6. read p_t

   save it - (replaces $p_{t-2.5}$)

   calculate RSUM2 (see section 4.3)

This part of the integration would have to be done in the Input Data Routine written to replace INRATDTA. The values $r_{t-1.25}$, $q_{t-1.25}$, $p_{t-1.25}$, r_t, q_t, p_t, YSUM1, PSUM1, RSUM1, YSUM2, PSUM2, RSUM2 should be stored in memory as shown in section 4.4.

i) In the demonstration program, the steering commands and telemetry output data are stored in memory in the form defined by the China Lake system. (This is done in lines A06-A0D and A2C-A33 respectively). In an actual system, these would be output through an I/O port to a D/A converter in the form defined by the hardware interface designed for the system used.

j) The subroutines enabling the execution of the ejection functions would have to be changed to execute the functions as defined by the specially designed hardware interface

used on the seat. These subroutines are (reference Table 2.3):

EJCTRTN (7B7-7B9) - enables SEQUENCE A functions.

CTPLTRTN (7Bf-7C1) - enables SEQUENCE B functions.

RKFSTM (887-889) - enables Rocket Ignition.

CKPCEM (8A2-8A6) - enables Fire PCEM.

PARSEP (A56-A58) - enables SEQUENCE D functions.

k) The code would have to be assembled to begin executing from location 0000.

APPENDIX A

The following listings show the yaw, pitch and roll input rate data, the
3 direction cosines and the steering commands generated at each step
(every 1.25 ms) in the execution of the vertical seeking maneuver.

A.1 Vertical Seeking Maneuver - 90° Roll Test

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0.00	0	0	0	0.000	1.000	0.000		
0001.25	000	000	-001	0.000	1.000	0.000		
0002.50	001	000	-001	0.000	1.000	0.000	BF	7F
0003.75	001	000	-002	0.000	1.000	0.000		
0005.00	002	000	-003	0.000	1.000	0.000	BF	7F
0006.25	002	000	-003	0.000	1.000	0.000		
0007.50	003	000	-004	0.000	1.000	0.000	BF	7F
0008.75	003	001	-005	0.000	1.000	0.000		
0010.00	003	001	-006	0.000	1.000	0.000	BF	7F
0011.25	004	001	-006	0.000	1.000	0.000		
0012.50	004	001	-007	0.000	1.000	0.000	BF	7F
0013.75	005	001	-008	0.000	1.000	0.000		
0015.00	005	001	-008	0.000	1.000	0.000	BF	7F
0016.25	006	001	-009	0.000	1.000	0.000		
0017.50	006	001	-010	0.000	1.000	0.000	BF	7F
0018.75	007	001	-011	0.000	1.000	0.000		
0020.00	007	001	-011	0.000	1.000	0.000	BF	7F
0021.25	008	002	-012	0.000	1.000	0.000		
0022.50	008	002	-012	0.000	1.000	0.000	BF	7F
0023.75	008	002	-013	0.000	1.000	0.000		
0025.00	009	002	-014	0.000	1.000	0.000	BF	7F
0026.25	009	002	-014	0.000	1.000	0.000		
0027.50	008	001	-015	0.000	1.000	0.000	BF	7F
0028.75	008	001	-016	0.000	1.000	0.000		
0030.00	008	000	-016	0.000	1.000	0.000	BF	7F
0031.25	008	000	-017	0.000	1.000	0.000		
0032.50	007	000	-017	0.000	1.000	0.000	BF	7F
0033.75	007	-000	-018	0.000	1.000	0.000		
0035.00	007	-001	-018	0.000	1.000	0.000	BF	7F
0036.25	007	-001	-019	0.000	1.000	0.000		
0037.50	006	-001	-020	0.000	1.000	0.000	BF	7F
0038.75	006	-002	-020	0.000	1.000	0.000		
0040.00	006	-002	-021	0.000	1.000	0.000	BF	7F
0041.25	006	-002	-021	0.000	1.000	0.000		
0042.50	005	-003	-022	0.000	1.000	0.000	BF	7F
0043.75	005	-003	-022	0.000	1.000	0.008		
0045.00	005	-003	-023	0.000	1.000	0.008	BF	7F
0046.25	005	-004	-023	0.000	1.000	0.008		
0047.50	004	-004	-024	0.000	1.000	0.008	BF	7F
0048.75	004	-005	-024	0.000	1.000	0.008		
0050.00	004	-005	-025	0.000	1.000	0.008	BF	7F
0051.25	004	-005	-024	0.000	1.000	0.008		
0052.50	003	-006	-024	0.000	1.000	0.008	BF	7F
0053.75	003	-006	-024	0.000	1.000	0.008		
0055.00	003	-007	-023	0.000	1.000	0.008	BF	7F
0056.25	002	-007	-023	0.000	1.000	0.008		
0057.50	002	-008	-022	0.000	1.000	0.008	BF	7F
0058.75	002	-008	-022	0.000	1.000	0.008		
0060.00	001	-009	-022	0.000	1.000	0.008	BF	7F
0061.25	001	-009	-021	0.000	1.000	0.008		
0062.50	001	-010	-021	0.000	1.000	0.008	BF	7F
0063.75	001	-010	-021	0.000	1.000	0.008		
0065.00	000	-010	-020	0.000	1.000	0.008	BF	7F
0066.25	000	-011	-020	0.000	1.000	0.016		
0067.50	-000	-011	-019	0.000	1.000	0.016	BE	7F
0068.75	-000	-012	-019	0.000	1.000	0.016		
0070.00	-001	-012	-019	0.000	1.000	0.016	BE	7F
0071.25	-001	-012	-018	0.000	1.000	0.016		
0072.50	-001	-013	-018	0.000	1.000	0.016	BE	7F
0073.75	-002	-013	-017	0.000	1.000	0.016		
0075.00	-002	-014	-017	0.000	1.000	0.016	BE	7F

T	R	Q	P	DC1	DC2	DC3	RL CMND	PC CMND
0076.25	-001	-014	-013	0.000	1.000	0.016		
0077.50	-000	-014	-010	0.000	1.000	0.016	BE	7F
0078.75	000	-014	-007	0.000	1.000	0.016		
0080.00	001	-014	-003	0.000	1.000	0.016	BE	7F
0081.25	002	-014	000	0.000	1.000	0.016		
0082.50	003	-014	003	0.000	1.000	0.016	BE	7F
0083.75	004	-014	007	0.000	1.000	0.016		
0085.00	004	-014	010	0.000	1.000	0.016	BE	7F
0086.25	005	-014	014	0.000	1.000	0.016		
0087.50	006	-014	017	0.000	1.000	0.016	BE	7F
0088.75	007	-014	021	0.000	1.000	0.016		
0090.00	008	-014	024	0.000	1.000	0.016	BE	7F
0091.25	008	-015	027	0.000	1.000	0.016		
0092.50	009	-015	031	0.000	1.000	0.016	BE	7F
0093.75	010	-015	034	0.000	1.000	0.016		
0095.00	011	-015	037	0.000	1.000	0.016	BE	7F
0096.25	011	-015	041	0.000	1.000	0.016		
0097.50	012	-015	044	0.000	1.000	0.016	BE	7F
0098.75	013	-015	048	0.000	1.000	0.016		
0100.00	014	-015	051	0.000	1.000	0.016	BE	7F
0101.25	015	-014	055	0.000	1.000	0.016		
0102.50	016	-013	059	0.000	1.000	0.016	BE	7F
0103.75	017	-012	063	0.000	1.000	0.016		
0105.00	018	-011	067	0.008	1.000	0.016	BE	7F
0106.25	020	-010	071	0.008	1.000	0.008		
0107.50	021	-009	075	0.008	1.000	0.008	BE	7F
0108.75	022	-008	079	0.008	1.000	0.008		
0110.00	023	-007	083	0.008	1.000	0.008	BE	7F
0111.25	024	-006	087	0.008	1.000	0.008		
0112.50	025	-006	091	0.008	1.000	0.000	BE	7F
0113.75	026	-005	095	0.008	1.000	0.000		
0115.00	027	-004	099	0.008	1.000	0.000	BE	7F
0116.25	028	-003	103	0.008	1.000	0.000		
0117.50	029	-002	107	0.008	1.000	-0.007	BF	7F
0118.75	031	-001	111	0.008	1.000	-0.007		
0120.00	032	000	115	0.008	1.000	-0.007	BF	7F
0121.25	033	001	119	0.008	1.000	-0.007		
0122.50	034	002	123	0.008	1.000	-0.015	BF	7F
0123.75	035	003	127	0.016	1.000	-0.015		
0125.00	036	004	131	0.016	1.000	-0.015	BF	7F
0126.25	036	004	134	0.016	0.999	-0.023		
0127.50	037	004	137	0.016	0.999	-0.023	BF	7F
0128.75	037	004	139	0.016	0.999	-0.023		
0130.00	038	005	142	0.016	0.999	-0.031	BF	7F
0131.25	038	005	145	0.016	0.999	-0.031		
0132.50	039	005	148	0.016	0.999	-0.031	BF	7F
0133.75	039	005	150	0.016	0.999	-0.038		
0135.00	040	006	153	0.016	0.999	-0.038	BF	7F
0136.25	040	006	156	0.016	0.998	-0.046		
0137.50	041	006	159	0.023	0.998	-0.046	BF	7F
0138.75	042	006	161	0.023	0.998	-0.046		
0140.00	042	006	164	0.023	0.998	-0.054	BF	7F
0141.25	043	006	167	0.023	0.998	-0.054		
0142.50	043	007	170	0.023	0.997	-0.061	BF	7F
0143.75	043	007	172	0.023	0.997	-0.061		
0145.00	044	007	175	0.023	0.997	-0.061	BF	7F
0146.25	044	007	178	0.023	0.997	-0.069		
0147.50	045	007	181	0.023	0.997	-0.069	BF	7F
0148.75	045	008	183	0.031	0.996	-0.077		
0150.00	046	008	186	0.031	0.996	-0.077	BF	7F

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0151.25	046	007	187	0.031	0.995	-0.034		
0152.50	047	006	188	0.031	0.995	-0.084	BF	7D
0153.75	048	005	189	0.031	0.995	-0.092		
0155.00	048	005	191	0.031	0.995	-0.092	BF	7D
0156.25	049	004	192	0.031	0.994	-0.100		
0157.50	049	003	193	0.031	0.994	-0.100	BF	7D
0158.75	050	002	194	0.031	0.993	-0.107		
0160.00	050	001	195	0.039	0.993	-0.107	BF	7D
0161.25	051	001	196	0.039	0.992	-0.115		
0162.50	052	000	197	0.039	0.992	-0.115	BF	7D
0163.75	052	-001	199	0.039	0.991	-0.123		
0165.00	053	-001	200	0.039	0.991	-0.123	BF	7D
0166.25	053	-002	201	0.039	0.990	-0.130		
0167.50	054	-003	202	0.039	0.990	-0.130	BF	7D
0168.75	054	-004	203	0.046	0.988	-0.138		
0170.00	055	-005	204	0.046	0.988	-0.138	BF	7D
0171.25	055	-005	205	0.046	0.987	-0.146		
0172.50	056	-006	207	0.046	0.987	-0.146	BF	7D
0173.75	056	-007	208	0.046	0.986	-0.154		
0175.00	057	-008	209	0.046	0.986	-0.154	BF	7D
0176.25	058	-008	210	0.046	0.985	-0.161		
0177.50	058	-009	211	0.046	0.985	-0.161	BF	7D
0178.75	059	-009	212	0.054	0.983	-0.169		
0180.00	060	-010	212	0.054	0.983	-0.169	C0	7C
0181.25	060	-010	213	0.054	0.982	-0.177		
0182.50	061	-011	214	0.054	0.982	-0.177	C0	7C
0183.75	062	-011	215	0.054	0.980	-0.184		
0185.00	062	-012	216	0.054	0.980	-0.184	C0	7C
0186.25	063	-012	217	0.062	0.978	-0.192		
0187.50	064	-013	217	0.062	0.978	-0.192	C0	7C
0188.75	064	-013	218	0.062	0.977	-0.199		
0190.00	065	-014	219	0.062	0.975	-0.207	C0	7C
0191.25	065	-014	220	0.062	0.975	-0.207		
0192.50	066	-015	221	0.062	0.973	-0.214	C0	7C
0193.75	067	-015	222	0.069	0.973	-0.214		
0195.00	067	-016	223	0.069	0.971	-0.222	C0	7B
0196.25	068	-016	223	0.069	0.971	-0.222		
0197.50	069	-017	224	0.069	0.969	-0.229	C0	7B
0198.75	069	-017	225	0.069	0.969	-0.229		
0200.00	070	-018	226	0.069	0.967	-0.237	C1	7B
0201.25	070	-018	227	0.077	0.965	-0.245		
0202.50	070	-018	228	0.077	0.965	-0.245	C1	7B
0203.75	070	-018	229	0.077	0.963	-0.252		
0205.00	070	-018	230	0.074	0.963	-0.252	C1	7B
0206.25	071	-018	231	0.074	0.961	-0.260		
0207.50	071	-018	232	0.074	0.961	-0.260	C1	7B
0208.75	071	-018	233	0.082	0.958	-0.267		
0210.00	071	-018	234	0.082	0.956	-0.275	C1	7A
0211.25	071	-018	235	0.082	0.956	-0.275		
0212.50	071	-018	236	0.082	0.953	-0.282	C1	7A
0213.75	072	-018	237	0.082	0.953	-0.282		
0215.00	072	-018	238	0.082	0.951	-0.290	C2	7A
0216.25	072	-018	239	0.089	0.948	-0.297		
0217.50	072	-018	240	0.089	0.948	-0.297	C2	7A
0218.75	072	-018	241	0.089	0.946	-0.304		
0220.00	072	-018	242	0.089	0.946	-0.304	C2	7A
0221.25	072	-018	243	0.089	0.943	-0.312		
0222.50	073	-018	244	0.097	0.940	-0.319	C2	7A
0223.75	073	-018	245	0.097	0.940	-0.319		
0225.00	073	-018	246	0.097	0.937	-0.326	C3	7A

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1201.25	024	-016	014	0.053	0.061	-0.984		

T	R	Q	P	DC1	DC2	DC3	RL.CMD	PC.CMD
0226.25	073	-018	246	0.027	0.237	-0.326		
0227.50	073	-019	247	0.097	0.935	-0.333	C3	79
0243.75	074	-020	247	0.097	0.932	-0.341		
0230.00	074	-020	248	0.104	0.931	-0.341	C3	79
0231.25	074	-021	248	0.104	0.928	-0.348		
0232.50	074	-021	249	0.101	0.926	-0.356	C3	79
0233.75	074	-022	249	0.101	0.926	-0.356		
0235.00	075	-023	250	0.101	0.923	-0.363	C3	79
0235.25	075	-023	250	0.108	0.922	-0.363		
0237.50	075	-024	251	0.108	0.919	-0.370	C4	79
0238.75	076	-024	251	0.108	0.916	-0.377		
0240.00	076	-025	251	0.108	0.916	-0.377	C4	79
0241.25	076	-026	252	0.108	0.913	-0.384		
0242.50	076	-026	252	0.115	0.909	-0.391	C4	78
0243.75	077	-027	253	0.115	0.909	-0.391		
0245.00	077	-027	253	0.115	0.906	-0.399	C5	78
0246.25	077	-028	254	0.115	0.906	-0.399		
0247.50	077	-029	254	0.115	0.903	-0.406	C5	78
0248.75	078	-029	255	0.122	0.899	-0.412		
0250.00	078	-030	255	0.122	0.899	-0.412	C5	78
0251.25	078	-031	255	0.122	0.895	-0.419		
0252.50	078	-031	255	0.119	0.892	-0.427	C5	78
0253.75	078	-032	255	0.119	0.892	-0.427		
0255.00	078	-033	255	0.126	0.888	-0.434	C6	77
0256.25	079	-033	255	0.126	0.884	-0.441		
0257.50	079	-034	255	0.126	0.884	-0.441	C6	77
0258.75	079	-035	255	0.126	0.880	-0.448		
0260.00	079	-035	255	0.126	0.877	-0.455	C6	77
0261.25	079	-036	255	0.126	0.877	-0.455		
0262.50	079	-037	255	0.133	0.872	-0.462	C7	77
0263.75	080	-038	255	0.133	0.872	-0.462		
0265.00	080	-038	255	0.133	0.869	-0.468	C7	77
0266.25	080	-039	254	0.129	0.865	-0.476		
0267.50	080	-040	254	0.129	0.865	-0.476	C7	77
0268.75	080	-041	254	0.135	0.860	-0.483		
0270.00	080	-041	254	0.135	0.856	-0.489	C8	77
0271.25	080	-042	254	0.135	0.856	-0.489		
0272.50	081	-043	254	0.135	0.852	-0.496	C8	77
0273.75	081	-043	254	0.135	0.848	-0.503		
0275.00	081	-044	254	0.142	0.847	-0.503	C8	76
0276.25	081	-044	254	0.142	0.843	-0.509		
0277.50	081	-045	253	0.142	0.843	-0.509	C9	76
0278.75	081	-045	252	0.138	0.839	-0.517		
0280.00	081	-046	252	0.144	0.834	-0.523	C9	76
0281.25	081	-046	251	0.144	0.834	-0.523		
0282.50	081	-047	250	0.144	0.830	-0.530	C9	76
0283.75	081	-047	250	0.144	0.825	-0.536		
0285.00	081	-047	249	0.144	0.825	-0.536	CA	76
0286.25	081	-048	249	0.151	0.820	-0.542		
0287.50	081	-048	248	0.151	0.820	-0.542	CA	76
0288.75	081	-049	247	0.145	0.816	-0.550		
0290.00	081	-049	247	0.145	0.811	-0.556	28	76
0291.25	082	-050	246	0.145	0.811	-0.556		
0292.50	082	-050	246	0.153	0.806	-0.563	28	76
0293.75	082	-051	245	0.153	0.801	-0.569		
0295.00	082	-051	244	0.153	0.801	-0.569	28	76
0296.25	082	-051	244	0.153	0.797	-0.575		
0297.50	082	-052	243	0.153	0.797	-0.575	28	76
0298.75	082	-052	243	0.154	0.791	-0.582		
0300.00	082	-053	242	0.154	0.786	-0.589	28	76

T	R	O	P	DC1	DC2	DC3	RL.(SMU)	PC.(...)
0301.25	082	-053	241	0.154	0.786	-0.588		
0302.50	082	-053	241	0.154	0.782	-0.594	CC	75
0303.75	081	-053	240	0.154	0.782	-0.594		
0305.00	081	-053	239	0.160	0.776	-0.600	CD	75
0306.25	081	-053	239	0.160	0.771	-0.606		
0307.50	081	-053	238	0.160	0.771	-0.606	CC	75
0308.75	081	-053	238	0.155	0.766	-0.614		
0310.00	081	-053	237	0.155	0.766	-0.614	CD	74
0311.25	081	-053	236	0.161	0.760	-0.619		
0312.50	080	-053	236	0.161	0.755	-0.625	CE	75
0313.75	080	-053	235	0.161	0.755	-0.625		
0315.00	080	-053	235	0.161	0.750	-0.631	CE	75
0316.25	080	-053	234	0.161	0.750	-0.631		
0317.50	080	-054	234	0.162	0.744	-0.638	CF	75
0318.75	080	-054	233	0.162	0.739	-0.644		
0320.00	079	-054	232	0.162	0.739	-0.644	CF	75
0321.25	079	-054	232	0.162	0.734	-0.650		
0322.50	079	-054	231	0.162	0.734	-0.650	D0	75
0323.75	079	-054	230	0.167	0.727	-0.655		
0325.00	079	-054	230	0.167	0.727	-0.655	D0	75
0326.25	079	-054	229	0.167	0.722	-0.661		
0327.50	079	-054	228	0.162	0.717	-0.668	D1	75
0329.75	079	-054	227	0.162	0.717	-0.668		
0330.00	079	-054	226	0.168	0.710	-0.673	D1	75
0331.25	079	-054	225	0.168	0.710	-0.673		
0332.50	079	-054	224	0.168	0.705	-0.679	D1	75
0333.75	079	-055	223	0.168	0.705	-0.679		
0335.00	078	-055	222	0.168	0.699	-0.684	D2	75
0336.25	078	-055	221	0.167	0.693	-0.691		
0337.50	078	-055	220	0.167	0.693	-0.691	D2	75
0338.75	078	-055	219	0.167	0.687	-0.696		
0340.00	078	-055	218	0.167	0.687	-0.696	D3	75
0341.25	078	-055	217	0.167	0.682	-0.701		
0342.50	078	-055	216	0.173	0.681	-0.701	D3	74
0343.75	078	-055	215	0.173	0.675	-0.707		
0345.00	078	-055	214	0.167	0.675	-0.708	D3	75
0346.25	078	-056	213	0.167	0.669	-0.713		
0347.50	078	-056	212	0.167	0.669	-0.713	D4	75
0348.75	078	-056	211	0.172	0.662	-0.718		
0350.00	078	-056	210	0.172	0.657	-0.723	D4	74
0351.25	078	-056	209	0.172	0.657	-0.723		
0352.50	077	-056	207	0.172	0.651	-0.729	D5	74
0353.75	077	-056	206	0.167	0.651	-0.730		
0355.00	077	-056	205	0.172	0.644	-0.735	D5	75
0356.25	077	-056	203	0.172	0.644	-0.735		
0357.50	077	-056	202	0.172	0.638	-0.740	D6	75
0358.75	076	-057	201	0.172	0.638	-0.740		
0360.00	076	-057	199	0.172	0.632	-0.745	D6	75
0361.25	076	-057	198	0.172	0.632	-0.745		
0362.50	076	-057	197	0.176	0.625	-0.750	D6	74
0363.75	076	-057	195	0.170	0.625	-0.751		
0365.00	075	-057	194	0.170	0.619	-0.755	D7	75
0366.25	075	-057	192	0.170	0.619	-0.756		
0367.50	075	-057	191	0.170	0.613	-0.761	D7	75
0368.75	075	-057	190	0.175	0.612	-0.761		
0370.00	074	-057	188	0.175	0.606	-0.765	D8	74
0371.25	074	-058	187	0.175	0.606	-0.765		
0372.50	074	-058	186	0.169	0.606	-0.767	D8	75
0373.75	074	-058	184	0.169	0.600	-0.771		
0375.00	074	-058	183	0.174	0.599	-0.771	D8	74

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0376.25	074	-058	182	0.174	0.593	-0.776		
0377.50	074	-058	181	0.174	0.593	-0.776	D9	74
0378.75	074	-058	181	0.174	0.586	-0.781		
0380.00	074	-058	180	0.167	0.586	-0.782	D9	75
0381.25	074	-058	179	0.167	0.580	-0.786		
0382.50	074	-058	178	0.172	0.579	-0.786	D9	74
0383.75	074	-058	177	0.172	0.573	-0.791		
0385.00	073	-058	176	0.172	0.573	-0.791	DA	74
0386.25	073	-058	175	0.172	0.573	-0.791		
0387.50	073	-058	174	0.172	0.567	-0.795	DA	74
0388.75	073	-058	174	0.170	0.565	-0.797		
0390.00	073	-058	173	0.170	0.559	-0.801	DB	75
0391.25	073	-058	172	0.170	0.559	-0.801		
0392.50	073	-058	171	0.170	0.552	-0.805	DB	75
0393.75	073	-058	170	0.170	0.552	-0.805		
0395.00	073	-058	169	0.174	0.545	-0.810	DC	74
0396.25	073	-058	169	0.174	0.545	-0.810		
0397.50	073	-058	168	0.168	0.545	-0.811	DC	75
0398.75	073	-058	167	0.168	0.538	-0.815		
0400.00	073	-058	166	0.168	0.538	-0.815	DC	75
0401.25	073	-058	165	0.168	0.532	-0.819		
0402.50	072	-058	165	0.172	0.531	-0.819	DD	74
0403.75	072	-057	164	0.172	0.531	-0.819		
0405.00	072	-057	163	0.172	0.524	-0.823	DD	74
0406.25	072	-057	163	0.166	0.524	-0.825		
0407.50	072	-057	162	0.166	0.518	-0.829	DD	75
0408.75	071	-057	161	0.170	0.516	-0.829		
0410.00	071	-057	161	0.170	0.516	-0.829	DD	75
0411.25	071	-057	160	0.170	0.510	-0.833		
0412.50	071	-056	160	0.170	0.510	-0.833	DE	75
0413.75	071	-056	159	0.170	0.503	-0.837		
0415.00	070	-056	158	0.163	0.503	-0.838	DE	75
0416.25	070	-056	158	0.167	0.502	-0.838		
0417.50	070	-056	157	0.167	0.495	-0.842	DF	75
0418.75	070	-056	156	0.167	0.495	-0.842		
0420.00	070	-055	156	0.167	0.489	-0.845	DF	75
0421.25	069	-055	155	0.167	0.489	-0.845		
0422.50	069	-055	154	0.167	0.489	-0.845	DF	75
0423.75	069	-055	154	0.164	0.481	-0.850		
0425.00	069	-055	153	0.164	0.481	-0.850	E0	75
0426.25	069	-055	152	0.164	0.474	-0.854		
0427.50	069	-055	151	0.164	0.474	-0.854	E0	75
0428.75	069	-054	150	0.164	0.474	-0.854		
0430.00	068	-054	149	0.164	0.467	-0.858	E1	75
0431.25	068	-054	148	0.168	0.466	-0.858		
0432.50	068	-054	147	0.168	0.466	-0.858	E1	75
0433.75	068	-054	146	0.161	0.459	-0.863		
0435.00	068	-054	145	0.161	0.459	-0.863	E1	75
0436.25	068	-053	143	0.161	0.453	-0.866		
0437.50	068	-053	142	0.164	0.451	-0.866	E2	75
0438.75	068	-053	141	0.164	0.451	-0.868		
0440.00	068	-053	140	0.164	0.444	-0.870	E2	75
0441.25	068	-053	139	0.164	0.444	-0.870		
0442.50	067	-053	138	0.157	0.444	-0.871	E2	75
0443.75	067	-053	137	0.157	0.438	-0.874		
0445.00	067	-053	136	0.161	0.436	-0.874	E3	75
0446.25	067	-053	135	0.161	0.436	-0.874		
0447.50	067	-052	134	0.161	0.429	-0.877	E3	75
0448.75	067	-052	133	0.161	0.429	-0.877		
0450.00	067	-052	132	0.161	0.429	-0.877	E3	75

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PO.CMND
0451.25	067	-052	130	0.161	0.422	-0.881		
0452.50	066	-052	128	0.157	0.421	-0.882	E4	75
0453.75	066	-052	126	0.157	0.421	-0.882		
0455.00	065	-051	123	0.157	0.414	-0.885	E4	75
0456.25	065	-051	121	0.157	0.414	-0.885		
0457.50	065	-051	119	0.157	0.414	-0.885	E4	75
0458.75	064	-051	117	0.157	0.407	-0.888		
0460.00	064	-051	115	0.160	0.406	-0.888	E5	75
0461.25	064	-051	113	0.153	0.406	-0.890		
0462.50	064	-051	111	0.153	0.406	-0.890	E5	76
0463.75	063	-051	108	0.153	0.399	-0.893		
0465.00	063	-051	106	0.153	0.399	-0.893	E5	76
0466.25	062	-051	104	0.153	0.399	-0.893		
0467.50	062	-050	102	0.153	0.392	-0.896	E5	76
0468.75	062	-050	100	0.156	0.391	-0.896		
0470.00	061	-050	098	0.156	0.391	-0.896	E5	76
0471.25	061	-050	096	0.149	0.391	-0.897		
0472.50	061	-050	094	0.149	0.384	-0.900	E6	76
0473.75	060	-050	092	0.149	0.384	-0.900		
0475.00	060	-050	089	0.149	0.384	-0.900	E6	76
0476.25	060	-050	090	0.152	0.383	-0.900		
0477.50	060	-050	091	0.152	0.383	-0.900	E6	76
0478.75	060	-050	091	0.152	0.376	-0.903		
0480.00	060	-050	092	0.152	0.376	-0.903	E6	76
0481.25	060	-050	093	0.145	0.376	-0.904		
0482.50	060	-050	094	0.145	0.376	-0.904	E6	75
0483.75	060	-050	094	0.145	0.368	-0.907		
0485.00	060	-049	095	0.148	0.367	-0.907	E7	76
0486.25	060	-049	096	0.148	0.367	-0.907		
0487.50	060	-049	096	0.148	0.367	-0.907	E7	76
0488.75	060	-049	097	0.148	0.360	-0.910		
0490.00	060	-049	097	0.148	0.360	-0.910	E7	76
0491.25	060	-049	098	0.140	0.360	-0.911		
0492.50	060	-049	099	0.140	0.360	-0.911	E7	77
0493.75	060	-049	099	0.143	0.352	-0.913		
0495.00	060	-049	100	0.143	0.352	-0.913	E8	76
0496.25	060	-049	101	0.143	0.352	-0.913		
0497.50	060	-049	102	0.143	0.352	-0.913	E8	76
0498.75	060	-049	102	0.143	0.345	-0.916		
0500.00	060	-049	103	0.143	0.345	-0.916	E8	76
0501.25	060	-048	103	0.138	0.344	-0.917		
0502.50	059	-048	102	0.138	0.344	-0.917	E9	77
0503.75	059	-047	102	0.138	0.336	-0.920		
0505.00	059	-047	101	0.138	0.336	-0.920	E9	77
0506.25	059	-047	101	0.138	0.336	-0.920		
0507.50	059	-046	101	0.138	0.336	-0.920	E9	77
0508.75	058	-046	100	0.138	0.329	-0.922		
0510.00	058	-045	100	0.141	0.328	-0.922	E9	76
0511.25	058	-045	100	0.141	0.328	-0.922		
0512.50	058	-044	099	0.134	0.328	-0.923	E9	77
0513.75	058	-044	099	0.134	0.321	-0.926		
0515.00	057	-043	099	0.134	0.321	-0.926	EA	77
0516.25	057	-043	098	0.134	0.321	-0.926		
0517.50	057	-043	098	0.134	0.321	-0.926	EA	77
0518.75	057	-042	098	0.136	0.313	-0.928		
0520.00	057	-042	097	0.136	0.313	-0.928	EA	77
0521.25	056	-041	097	0.136	0.313	-0.928		
0522.50	056	-041	097	0.136	0.313	-0.928	EA	77
0523.75	056	-041	096	0.129	0.305	-0.932		
0525.00	056	-040	096	0.129	0.305	-0.932	EB	77

T	R	Q	P	DC1	DC2	DC3	RL.CMHD	PC.CMHD
0526.25	056	-040	095	0.129	0.305	-0.932		
0527.50	055	-039	093	0.131	0.304	-0.932	EB	77
0528.75	055	-039	092	0.131	0.297	-0.934		
0530.00	055	-039	090	0.131	0.297	-0.934	EB	77
0531.25	054	-038	088	0.131	0.297	-0.934		
0532.50	054	-038	087	0.131	0.297	-0.934	EB	77
0533.75	054	-038	085	0.131	0.297	-0.934		
0535.00	053	-037	084	0.131	0.290	-0.936	EC	77
0536.25	053	-037	083	0.133	0.289	-0.936		
0537.50	053	-037	081	0.126	0.289	-0.937	EC	77
0538.75	053	-037	079	0.126	0.289	-0.937		
0540.00	052	-036	078	0.126	0.289	-0.937	EC	77
0541.25	052	-036	076	0.126	0.281	-0.940		
0542.50	052	-036	075	0.126	0.281	-0.940	ED	77
0543.75	051	-036	074	0.126	0.281	-0.940		
0545.00	051	-035	072	0.126	0.281	-0.940	ED	77
0546.25	051	-035	070	0.128	0.280	-0.940		
0547.50	051	-034	069	0.128	0.273	-0.942	ED	77
0548.75	050	-034	067	0.128	0.273	-0.942		
0550.00	050	-034	066	0.128	0.273	-0.942	ED	77
0551.25	050	-034	065	0.121	0.273	-0.943		
0552.50	049	-034	064	0.121	0.273	-0.943	ED	78
0553.75	049	-034	064	0.121	0.273	-0.943		
0555.00	049	-033	063	0.121	0.265	-0.945	EE	78
0556.25	048	-033	062	0.123	0.264	-0.945		
0557.50	048	-033	061	0.123	0.264	-0.945	EE	78
0558.75	048	-033	060	0.123	0.264	-0.945		
0560.00	047	-033	060	0.123	0.264	-0.945	EE	78
0561.25	047	-033	059	0.123	0.264	-0.945		
0562.50	047	-033	058	0.123	0.264	-0.945	EE	78
0563.75	047	-033	057	0.123	0.257	-0.947		
0565.00	046	-033	056	0.123	0.257	-0.947	EE	78
0566.25	046	-033	055	0.117	0.256	-0.948		
0567.50	046	-032	055	0.117	0.256	-0.948	EE	78
0568.75	045	-032	054	0.117	0.256	-0.948		
0570.00	045	-032	053	0.117	0.256	-0.948	EE	78
0571.25	045	-032	052	0.117	0.256	-0.948		
0572.50	044	-032	052	0.117	0.249	-0.949	EF	78
0573.75	044	-032	051	0.117	0.249	-0.949		
0575.00	044	-032	050	0.117	0.249	-0.949	EF	78
0576.25	044	-032	051	0.117	0.249	-0.949		
0577.50	044	-032	052	0.119	0.248	-0.949	EF	78
0578.75	044	-031	053	0.119	0.248	-0.949		
0580.00	044	-031	053	0.119	0.248	-0.949	EF	78
0581.25	044	-031	054	0.111	0.248	-0.950		
0582.50	044	-031	055	0.111	0.240	-0.952	EF	78
0583.75	045	-030	055	0.111	0.240	-0.952		
0585.00	045	-030	057	0.111	0.240	-0.952	EF	78
0586.25	045	-030	058	0.111	0.240	-0.952		
0587.50	045	-030	059	0.111	0.240	-0.952	EF	78
0588.75	045	-029	060	0.113	0.240	-0.952		
0590.00	045	-029	061	0.113	0.240	-0.952	EF	78
0591.25	045	-029	062	0.113	0.232	-0.954		
0592.50	045	-028	063	0.113	0.232	-0.954	FO	78
0593.75	045	-028	064	0.113	0.232	-0.954		
0595.00	045	-028	064	0.113	0.232	-0.954	FO	78
0596.25	046	-028	065	0.113	0.232	-0.954		
0597.50	046	-027	066	0.113	0.232	-0.954	FO	78
0598.75	046	-027	067	0.105	0.224	-0.957		
0600.00	046	-027	068	0.107	0.224	-0.957	FO	79

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0601.25	046	-027	066	0.107	0.224	-0.957		
0602.50	045	-026	065	0.107	0.224	-0.957	F0	79
0603.75	045	-026	064	0.107	0.224	-0.957		
0605.00	045	-026	063	0.107	0.224	-0.957	F0	79
0606.25	044	-026	061	0.107	0.216	-0.958		
0607.50	044	-025	060	0.107	0.216	-0.958	F1	79
0608.75	044	-025	058	0.107	0.216	-0.958		
0610.00	043	-025	057	0.107	0.216	-0.958	F1	79
0611.25	043	-025	056	0.109	0.215	-0.958		
0612.50	043	-024	054	0.109	0.215	-0.958	F1	79
0613.75	043	-024	053	0.109	0.215	-0.958		
0615.00	042	-024	052	0.109	0.208	-0.960	F1	79
0616.25	042	-024	050	0.109	0.208	-0.960		
0617.50	042	-023	049	0.101	0.208	-0.961	F1	79
0618.75	041	-023	048	0.101	0.208	-0.961		
0620.00	041	-023	046	0.101	0.208	-0.961	F1	79
0621.25	041	-023	045	0.101	0.208	-0.961		
0622.50	041	-022	043	0.103	0.207	-0.961	F1	79
0623.75	040	-022	042	0.103	0.207	-0.961		
0625.00	040	-022	041	0.103	0.199	-0.962	F2	79
0626.25	039	-022	039	0.103	0.199	-0.962		
0627.50	039	-022	038	0.103	0.199	-0.962	F2	79
0628.75	039	-022	036	0.103	0.199	-0.962		
0630.00	038	-022	034	0.103	0.199	-0.962	F2	79
0631.25	038	-022	033	0.103	0.199	-0.962		
0632.50	037	-022	031	0.103	0.199	-0.962	F2	79
0633.75	037	-022	030	0.103	0.199	-0.962		
0635.00	037	-022	028	0.104	0.199	-0.962	F2	79
0636.25	036	-022	026	0.104	0.199	-0.962		
0637.50	036	-022	025	0.104	0.199	-0.962	F2	79
0638.75	035	-022	023	0.104	0.199	-0.962		
0640.00	035	-022	021	0.097	0.199	-0.963	F2	79
0641.25	035	-023	020	0.097	0.191	-0.964		
0642.50	034	-023	018	0.097	0.191	-0.964	F2	79
0643.75	034	-023	017	0.097	0.191	-0.964		
0645.00	033	-023	015	0.097	0.191	-0.964	F2	79
0646.25	033	-023	014	0.097	0.191	-0.964		
0647.50	033	-023	012	0.097	0.191	-0.964	F2	79
0648.75	032	-023	011	0.097	0.191	-0.964		
0650.00	032	-023	009	0.098	0.190	-0.964	F2	79
0651.25	032	-023	011	0.098	0.190	-0.964		
0652.50	032	-022	014	0.098	0.190	-0.964	F2	79
0653.75	033	-022	017	0.098	0.190	-0.964		
0655.00	033	-022	019	0.098	0.190	-0.964	F2	79
0656.25	033	-022	022	0.098	0.190	-0.964		
0657.50	034	-021	025	0.098	0.190	-0.964	F2	79
0658.75	034	-021	027	0.098	0.190	-0.964		
0660.00	034	-021	030	0.098	0.190	-0.964	F2	79
0661.25	035	-021	033	0.098	0.190	-0.964		
0662.50	035	-021	035	0.091	0.190	-0.965	F2	7A
0663.75	035	-020	038	0.091	0.190	-0.965		
0665.00	035	-020	041	0.092	0.182	-0.967	F3	7A
0666.25	036	-020	043	0.092	0.182	-0.967		
0667.50	036	-019	046	0.092	0.182	-0.967	F3	7A
0668.75	036	-019	049	0.092	0.182	-0.967		
0670.00	037	-019	051	0.092	0.182	-0.967	F3	7A
0671.25	037	-019	054	0.092	0.182	-0.967		
0672.50	037	-018	056	0.092	0.182	-0.967	F3	7A
0673.75	038	-018	059	0.092	0.182	-0.967		
0675.00	038	-018	062	0.092	0.175	-0.968	F3	7A

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0676.25	038	-018	051	0.022	0.175	-0.968		
0677.50	038	-017	060	0.022	0.175	-0.968	F3	7A
0678.75	038	-017	059	0.024	0.174	-0.968		
0680.00	039	-016	057	0.024	0.174	-0.968	F3	7A
0681.25	039	-016	056	0.024	0.174	-0.968		
0682.50	039	-016	055	0.024	0.174	-0.968	F3	7A
0683.75	039	-015	054	0.094	0.166	-0.969		
0685.00	039	-015	053	0.094	0.166	-0.969	F4	7A
0686.25	040	-015	052	0.094	0.166	-0.969		
0687.50	040	-014	051	0.094	0.166	-0.969	F4	7A
0688.75	040	-014	050	0.094	0.166	-0.969		
0690.00	040	-014	049	0.094	0.166	-0.969	F4	7A
0691.25	040	-013	048	0.087	0.166	-0.970		
0692.50	041	-013	046	0.087	0.166	-0.970	F4	7A
0693.75	041	-013	045	0.087	0.158	-0.971		
0695.00	041	-012	044	0.087	0.158	-0.971	F4	7A
0696.25	041	-012	043	0.087	0.158	-0.971		
0697.50	041	-012	042	0.087	0.158	-0.971	F4	7A
0698.75	042	-011	041	0.087	0.158	-0.971		
0700.00	042	-011	040	0.087	0.158	-0.971	F4	7A
0701.25	041	-011	037	0.087	0.158	-0.971		
0702.50	040	-011	033	0.087	0.158	-0.971	F4	7A
0703.75	039	-011	030	0.088	0.157	-0.971		
0705.00	038	-011	027	0.088	0.157	-0.971	F4	7A
0706.25	038	-011	024	0.088	0.157	-0.971		
0707.50	037	-011	021	0.088	0.150	-0.972	F5	7A
0708.75	036	-011	017	0.088	0.150	-0.972		
0710.00	035	-011	014	0.088	0.150	-0.972	F5	7A
0711.25	034	-011	011	0.088	0.150	-0.972		
0712.50	033	-011	008	0.088	0.150	-0.972	F5	7A
0713.75	032	-011	004	0.088	0.150	-0.972		
0715.00	032	-011	001	0.088	0.150	-0.972	F5	7A
0716.25	031	-012	-002	0.088	0.150	-0.972		
0717.50	030	-012	-006	0.089	0.149	-0.972	F5	7A
0718.75	029	-012	-009	0.089	0.149	-0.972		
0720.00	028	-012	-012	0.089	0.149	-0.972	F5	7A
0721.25	027	-012	-015	0.089	0.149	-0.972		
0722.50	027	-012	-019	0.089	0.149	-0.972	F5	7A
0723.75	026	-012	-022	0.089	0.149	-0.972		
0725.00	025	-012	-025	0.089	0.149	-0.972	F5	7A
0726.25	025	-012	-024	0.089	0.149	-0.972		
0727.50	025	-013	-023	0.089	0.149	-0.972	F5	7A
0728.75	024	-013	-022	0.089	0.149	-0.972		
0730.00	024	-013	-022	0.089	0.149	-0.972	F5	7A
0731.25	024	-014	-021	0.089	0.149	-0.972		
0732.50	024	-014	-020	0.082	0.149	-0.973	F5	7A
0733.75	024	-014	-019	0.082	0.149	-0.973		
0735.00	024	-015	-019	0.082	0.149	-0.973	F5	7A
0736.25	024	-015	-018	0.083	0.149	-0.973		
0737.50	023	-015	-017	0.083	0.149	-0.973	F5	7A
0738.75	023	-016	-016	0.083	0.149	-0.973		
0740.00	023	-016	-015	0.083	0.149	-0.973	F5	7A
0741.25	023	-016	-014	0.083	0.149	-0.973		
0742.50	023	-017	-014	0.083	0.149	-0.973	F5	7A
0743.75	023	-017	-013	0.083	0.149	-0.973		
0745.00	022	-017	-012	0.083	0.149	-0.973	F5	7A
0746.25	022	-018	-011	0.083	0.149	-0.973		
0747.50	022	-018	-011	0.083	0.149	-0.973	F5	7A
0748.75	022	-019	-010	0.083	0.149	-0.973		
0750.00	022	-019	-009	0.083	0.149	-0.973	F5	7A

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND

T	R	Q	P	DC1	LC2	LC3	RL.CMND	PS.CMND
0751.25	023	-018	-005	0.083	0.149	-0.973		
0752.50	023	-018	-002	0.083	0.149	-0.973	F5	7A
0753.75	024	-017	002	0.083	0.149	-0.973		
0755.00	025	-017	005	0.083	0.149	-0.973	F5	7A
0756.25	026	-016	009	0.083	0.149	-0.973		
0757.50	026	-016	012	0.084	0.148	-0.973	F5	7A
0758.75	027	-015	016	0.084	0.148	-0.973		
0760.00	028	-014	020	0.084	0.148	-0.973	F5	7A
0761.25	029	-014	023	0.084	0.148	-0.973		
0762.50	030	-013	027	0.084	0.148	-0.973	F5	7A
0763.75	030	-013	030	0.076	0.148	-0.974		
0765.00	031	-012	033	0.076	0.148	-0.974	F5	7B
0766.25	032	-012	037	0.076	0.148	-0.974		
0767.50	032	-011	041	0.076	0.148	-0.974	F5	7B
0768.75	033	-011	044	0.076	0.148	-0.974		
0770.00	034	-010	048	0.076	0.148	-0.974	F5	7B
0771.25	035	-010	051	0.076	0.148	-0.974		
0772.50	035	-009	055	0.076	0.148	-0.974	F5	7B
0773.75	036	-008	058	0.077	0.147	-0.974		
0775.00	037	-008	062	0.077	0.147	-0.974	F5	7B
0776.25	037	-008	060	0.077	0.147	-0.974		
0777.50	036	-007	058	0.077	0.147	-0.974	F5	7B
0778.75	036	-007	056	0.077	0.147	-0.974		
0780.00	036	-006	055	0.077	0.140	-0.975	F6	7B
0781.25	036	-006	053	0.077	0.140	-0.975		
0782.50	035	-006	051	0.077	0.140	-0.975	F6	7B
0783.75	035	-005	049	0.077	0.140	-0.975		
0785.00	035	-005	047	0.077	0.140	-0.975	F6	7B
0786.25	035	-005	046	0.077	0.140	-0.975		
0787.50	034	-004	044	0.078	0.139	-0.975	F6	7A
0788.75	034	-004	042	0.078	0.139	-0.975		
0790.00	034	-004	040	0.078	0.139	-0.975	F6	7A
0791.25	034	-003	038	0.078	0.132	-0.976		
0792.50	033	-003	037	0.078	0.132	-0.976	F6	7A
0793.75	033	-003	035	0.078	0.132	-0.976		
0795.00	033	-002	033	0.078	0.132	-0.976	F6	7A
0796.25	033	-002	031	0.078	0.132	-0.976		
0797.50	032	-002	030	0.078	0.132	-0.976	F6	7A
0798.75	032	-001	028	0.078	0.132	-0.976		
0800.00	032	-001	026	0.078	0.132	-0.976	F6	7A
0801.25	031	-001	022	0.078	0.132	-0.976		
0802.50	030	-001	018	0.079	0.131	-0.976	F6	7A
0803.75	029	-002	014	0.079	0.131	-0.976		
0805.00	028	-002	010	0.079	0.131	-0.976	F6	7A
0806.25	027	-002	007	0.079	0.131	-0.976		
0807.50	026	-003	003	0.079	0.131	-0.976	F6	7A
0808.75	025	-003	-001	0.079	0.131	-0.976		
0810.00	024	-003	-005	0.079	0.131	-0.976	F6	7A
0811.25	023	-004	-009	0.079	0.131	-0.976		
0812.50	022	-004	-013	0.079	0.131	-0.976	F6	7A
0813.75	021	-004	-017	0.079	0.131	-0.976		
0815.00	021	-004	-021	0.079	0.131	-0.976	F6	7A
0816.25	020	-005	-025	0.079	0.131	-0.976		
0817.50	019	-005	-029	0.079	0.131	-0.976	F6	7A
0818.75	018	-005	-032	0.079	0.131	-0.976		
0820.00	017	-005	-036	0.079	0.131	-0.976	F6	7A
0821.25	016	-006	-040	0.079	0.131	-0.976		
0822.50	015	-006	-044	0.079	0.131	-0.976	F6	7A
0823.75	014	-007	-048	0.079	0.131	-0.976		
0825.00	013	-007	-052	0.080	0.130	-0.976	F6	7A

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0826.25	013	-007	-049	0.080	0.130	-0.976		
0827.50	014	-007	-047	0.080	0.130	-0.976	F6	7A
0828.75	014	-007	-044	0.080	0.130	-0.976		
0830.00	015	-007	-042	0.080	0.130	-0.976	F6	7A
0831.25	015	-008	-039	0.080	0.130	-0.976		
0832.50	016	-008	-036	0.080	0.130	-0.976	F6	7A
0833.75	016	-008	-034	0.080	0.130	-0.976		
0835.00	017	-008	-031	0.080	0.130	-0.976	F6	7A
0836.25	017	-008	-029	0.080	0.130	-0.976		
0837.50	018	-008	-026	0.080	0.130	-0.976	F6	7A
0838.75	018	-009	-023	0.080	0.130	-0.976		
0840.00	018	-009	-021	0.080	0.138	-0.975	F6	7A
0841.25	019	-009	-018	0.080	0.138	-0.975		
0842.50	019	-009	-016	0.080	0.138	-0.975	F6	7A
0843.75	020	-009	-013	0.080	0.138	-0.975		
0845.00	020	-009	-010	0.080	0.138	-0.975	F6	7A
0846.25	021	-009	-008	0.073	0.138	-0.975		
0847.50	021	-010	-005	0.073	0.138	-0.975	F6	7B
0848.75	021	-010	-003	0.073	0.138	-0.975		
0850.00	022	-010	000	0.073	0.138	-0.975	F6	7B
0851.25	023	-010	004	0.073	0.138	-0.975		
0852.50	024	-009	008	0.073	0.138	-0.975	F6	7B
0853.75	025	-009	012	0.074	0.138	-0.975		
0855.00	026	-009	016	0.074	0.138	-0.975	F6	7B
0856.25	026	-008	021	0.074	0.138	-0.975		
0857.50	027	-008	025	0.074	0.138	-0.975	F6	7B
0858.75	028	-008	029	0.074	0.138	-0.975		
0860.00	029	-007	033	0.074	0.138	-0.975	F6	7B
0861.25	030	-007	037	0.074	0.138	-0.975		
0862.50	031	-007	041	0.074	0.138	-0.975	F6	7B
0863.75	032	-007	045	0.074	0.138	-0.975		
0865.00	033	-006	049	0.074	0.138	-0.975	F6	7B
0866.25	033	-006	053	0.074	0.138	-0.975		
0867.50	034	-006	057	0.074	0.138	-0.975	F6	7B
0868.75	035	-005	061	0.074	0.138	-0.975		
0870.00	036	-005	065	0.075	0.137	-0.975	F6	7B
0871.25	037	-005	070	0.075	0.129	-0.976		
0872.50	038	-004	074	0.075	0.129	-0.976	F6	7B
0873.75	039	-004	078	0.075	0.129	-0.976		
0875.00	040	-004	082	0.075	0.129	-0.976	F6	7B
0876.25	039	-004	079	0.075	0.129	-0.976		
0877.50	039	-004	077	0.075	0.122	-0.977	F7	7B
0878.75	038	-004	074	0.075	0.122	-0.977		
0880.00	038	-003	071	0.075	0.122	-0.977	F7	7B
0881.25	037	-003	069	0.075	0.122	-0.977		
0882.50	037	-003	066	0.075	0.122	-0.977	F7	7B
0883.75	036	-003	064	0.075	0.121	-0.977		
0885.00	036	-003	061	0.075	0.114	-0.978	F7	7B
0886.25	035	-003	058	0.075	0.114	-0.978		
0887.50	035	-003	056	0.075	0.114	-0.978	F7	7B
0888.75	034	-003	053	0.075	0.114	-0.978		
0890.00	034	-003	051	0.075	0.114	-0.978	F7	7B
0891.25	033	-003	048	0.075	0.114	-0.978		
0892.50	033	-002	046	0.075	0.114	-0.978	F7	7B
0893.75	032	-002	043	0.075	0.106	-0.979		
0895.00	032	-002	040	0.075	0.106	-0.979	F8	7B
0896.75	031	-002	038	0.075	0.106	-0.979		
0897.50	031	-002	035	0.076	0.105	-0.979	F8	7B
0898.75	030	-002	032	0.076	0.105	-0.979		
0900.00	030	-002	030	0.076	0.105	-0.979	F8	7B

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0901.25	029	-002	026	0.076	0.105	-0.979		
0902.50	028	-002	022	0.076	0.105	-0.979	F8	
0903.75	027	-002	019	0.076	0.105	-0.979		
0905.00	026	-002	015	0.076	0.105	-0.979	F8	
0906.25	025	-003	011	0.076	0.105	-0.979		
0907.50	024	-003	008	0.076	0.105	-0.979	F8	
0908.75	023	-003	004	0.076	0.105	-0.979		
0910.00	023	-003	000	0.076	0.105	-0.979	F8	
0911.25	022	-003	-003	0.076	0.105	-0.979		
0912.50	021	-003	-007	0.076	0.105	-0.979	F8	
0913.75	020	-004	-011	0.076	0.105	-0.979		
0915.00	019	-004	-014	0.076	0.105	-0.979	F8	
0916.25	018	-004	-018	0.076	0.105	-0.979		
0917.50	017	-004	-022	0.077	0.105	-0.979	F8	
0918.75	016	-004	-026	0.077	0.105	-0.979		
0920.00	016	-004	-029	0.077	0.105	-0.979	F8	
0921.25	015	-004	-033	0.077	0.105	-0.979		
0922.50	014	-005	-037	0.077	0.105	-0.979	F8	
0923.75	013	-005	-040	0.077	0.105	-0.979		
0925.00	012	-005	-044	0.077	0.105	-0.979	F8	7B
0926.25	012	-005	-042	0.077	0.105	-0.979		
0927.50	013	-005	-039	0.077	0.105	-0.979	F8	7B
0928.75	013	-005	-037	0.077	0.105	-0.979		
0930.00	014	-005	-034	0.077	0.105	-0.979	F8	7B
0931.25	014	-006	-032	0.077	0.105	-0.979		
0932.50	015	-006	-030	0.077	0.105	-0.979	F8	7B
0933.75	015	-006	-027	0.077	0.105	-0.979		
0935.00	016	-006	-025	0.077	0.105	-0.979	F8	7B
0936.25	016	-006	-022	0.077	0.105	-0.979		
0937.50	017	-006	-020	0.077	0.105	-0.979	F8	7B
0938.75	018	-007	-018	0.077	0.105	-0.979		
0940.00	018	-007	-015	0.077	0.105	-0.979	F8	7B
0941.25	019	-007	-013	0.077	0.105	-0.979		
0942.50	019	-007	-011	0.077	0.105	-0.979	F8	7B
0943.75	020	-007	-008	0.077	0.105	-0.979		
0945.00	020	-007	-006	0.077	0.105	-0.979	F8	7B
0946.25	021	-007	-003	0.069	0.105	-0.979		
0947.50	021	-008	-001	0.069	0.105	-0.979	F8	7B
0948.75	021	-008	001	0.070	0.104	-0.979		
0950.00	022	-008	004	0.070	0.104	-0.979	F8	7B
0951.25	023	-008	007	0.070	0.104	-0.979		
0952.50	023	-007	010	0.070	0.104	-0.979	F8	7B
0953.75	024	-007	013	0.070	0.104	-0.979		
0955.00	025	-007	017	0.070	0.104	-0.979	F8	7B
0956.25	025	-006	020	0.070	0.104	-0.979		
0957.50	026	-006	023	0.070	0.104	-0.979	F8	7B
0958.75	027	-006	026	0.070	0.104	-0.979		
0960.00	028	-005	030	0.070	0.104	-0.979	F8	7B
0961.25	028	-005	033	0.070	0.104	-0.979		
0962.50	029	-005	036	0.070	0.104	-0.979	F8	7B
0963.75	030	-005	039	0.070	0.104	-0.979		
0965.00	030	-004	042	0.070	0.104	-0.979	F8	7B
0966.25	031	-004	045	0.070	0.104	-0.979		
0967.50	032	-004	049	0.071	0.104	-0.979	F8	7B
0968.75	032	-003	052	0.071	0.104	-0.979		
0970.00	033	-003	055	0.071	0.104	-0.979	F8	7B
0971.25	034	-003	058	0.071	0.104	-0.979		
0972.50	034	-002	062	0.071	0.104	-0.979	F8	7B
0973.75	035	-002	065	0.071	0.104	-0.979		
0975.00	036	-002	068	0.071	0.104	-0.979	F8	7B

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0975.25	035	-002	065	0.071	0.096	-0.980		
0977.50	035	-002	063	0.071	0.096	-0.980	F8	7B
0978.75	034	-002	061	0.071	0.096	-0.980		
0980.00	034	-002	058	0.071	0.096	-0.980	F8	7B
0981.25	034	-002	056	0.071	0.096	-0.980		
0982.50	033	-002	054	0.071	0.096	-0.980	F8	7B
0983.75	033	-002	051	0.071	0.088	-0.981		
0985.00	032	-001	049	0.071	0.088	-0.981	F9	7B
0986.25	032	-001	047	0.071	0.088	-0.981		
0987.50	032	-001	044	0.071	0.088	-0.981	F9	7B
0988.75	031	-001	042	0.071	0.088	-0.981		
0990.00	031	-001	040	0.071	0.088	-0.981	F9	7B
0991.25	030	-001	037	0.071	0.088	-0.981		
0992.50	030	-001	035	0.071	0.088	-0.981	F9	7B
0993.75	029	-001	032	0.071	0.088	-0.981		
0995.00	029	-001	030	0.071	0.088	-0.981	F9	7B
0996.25	028	-001	028	0.071	0.080	-0.981		
0997.50	028	-001	025	0.071	0.080	-0.981	F9	7B
0998.75	027	-001	023	0.072	0.080	-0.981		
1000.00	027	-001	021	0.072	0.080	-0.981	F9	7B
1001.25	026	-001	018	0.072	0.080	-0.981		
1002.50	025	-001	015	0.072	0.080	-0.981	F9	7B
1003.75	024	-002	012	0.072	0.080	-0.981		
1005.00	024	-002	010	0.072	0.080	-0.981	F9	7B
1006.25	023	-002	007	0.072	0.080	-0.981		
1007.50	022	-002	004	0.072	0.080	-0.981	F9	7B
1008.75	021	-003	001	0.072	0.080	-0.981		
1010.00	021	-003	-001	0.072	0.080	-0.981	F9	7B
1011.25	020	-003	-004	0.072	0.080	-0.981		
1012.50	019	-003	-007	0.072	0.080	-0.981	F9	7B
1013.75	018	-004	-010	0.072	0.080	-0.981		
1015.00	017	-004	-013	0.072	0.080	-0.981	F9	7B
1016.25	017	-004	-015	0.072	0.080	-0.981		
1017.50	016	-004	-018	0.072	0.080	-0.981	F9	7B
1018.75	015	-005	-021	0.072	0.080	-0.981		
1020.00	014	-005	-024	0.072	0.080	-0.981	F9	7B
1021.25	013	-005	-027	0.072	0.080	-0.981		
1022.50	013	-005	-029	0.073	0.079	-0.981	F9	7B
1023.75	012	-006	-032	0.073	0.079	-0.981		
1025.00	011	-006	-035	0.073	0.079	-0.981	F9	7B
1026.25	011	-006	-033	0.073	0.079	-0.981		
1027.50	011	-006	-031	0.073	0.079	-0.981	F9	7B
1028.75	012	-007	-029	0.073	0.079	-0.981		
1030.00	012	-007	-027	0.073	0.079	-0.981	F9	7B
1031.25	012	-007	-025	0.073	0.079	-0.981		
1032.50	013	-007	-024	0.073	0.079	-0.981	F9	7B
1033.75	013	-008	-022	0.073	0.079	-0.981		
1035.00	013	-008	-020	0.073	0.079	-0.981	F9	7B
1036.25	014	-008	-018	0.073	0.079	-0.981		
1037.50	014	-009	-016	0.073	0.079	-0.981	F9	7B
1038.75	014	-009	-014	0.073	0.079	-0.981		
1040.00	014	-009	-012	0.073	0.079	-0.981	F9	7B
1041.25	015	-009	-010	0.073	0.079	-0.981		
1042.50	015	-010	-004	0.073	0.079	-0.981	F9	7B
1043.75	015	-010	-007	0.073	0.079	-0.981		
1045.00	016	-010	-005	0.073	0.079	-0.981	F9	7B
1046.25	016	-010	-003	0.073	0.079	-0.981		
1047.50	016	-011	-001	0.073	0.079	-0.981	F9	7B
1048.75	017	-011	001	0.073	0.079	-0.981		
1050.00	017	-011	003	0.073	0.079	-0.981	F9	7B

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1051.25	017	-011	005	0.065	0.079	-0.982		
1052.50	018	-011	007	0.065	0.079	-0.982	F9	7B
1053.75	019	-010	010	0.065	0.079	-0.982		
1055.00	019	-010	012	0.065	0.079	-0.982	F9	7B
1056.25	020	-010	014	0.065	0.079	-0.982		
1057.50	020	-010	016	0.066	0.079	-0.982	F9	7B
1058.75	021	-010	018	0.066	0.079	-0.982		
1060.00	021	-009	021	0.066	0.079	-0.982	F9	7B
1061.25	022	-009	023	0.066	0.079	-0.982		
1062.50	022	-009	025	0.066	0.079	-0.982	F9	7B
1063.75	023	-009	027	0.066	0.079	-0.982		
1065.00	023	-009	029	0.066	0.079	-0.982	F9	7B
1066.25	024	-008	032	0.066	0.079	-0.982		
1067.50	025	-008	034	0.066	0.079	-0.982	F9	7B
1068.75	025	-008	036	0.066	0.079	-0.982		
1070.00	026	-008	038	0.066	0.079	-0.982	F9	7B
1071.25	026	-008	040	0.066	0.079	-0.982		
1072.50	027	-007	043	0.066	0.079	-0.982	F9	7B
1073.75	027	-007	045	0.066	0.079	-0.982		
1075.00	028	-007	047	0.066	0.079	-0.982	F9	7B
1076.25	028	-007	046	0.066	0.079	-0.982		
1077.50	027	-007	043	0.066	0.078	-0.982	F9	7B
1078.75	027	-007	042	0.066	0.078	-0.982		
1080.00	026	-007	040	0.066	0.078	-0.982	F9	7B
1081.25	026	-007	038	0.066	0.078	-0.982		
1082.50	026	-007	036	0.066	0.078	-0.982	F9	7B
1083.75	025	-007	034	0.066	0.071	-0.983		
1085.00	025	-006	032	0.066	0.071	-0.983	FA	7B
1086.25	025	-006	031	0.066	0.071	-0.983		
1087.50	024	-006	029	0.066	0.071	-0.983	FA	7B
1088.75	024	-006	027	0.066	0.071	-0.983		
1090.00	024	-006	025	0.066	0.071	-0.983	FA	7B
1091.25	023	-006	023	0.066	0.071	-0.983		
1092.50	023	-006	022	0.066	0.071	-0.983	FA	7B
1093.75	022	-006	020	0.066	0.071	-0.983		
1095.00	022	-006	018	0.066	0.071	-0.983	FA	7B
1096.25	022	-006	016	0.066	0.071	-0.983		
1097.50	021	-006	015	0.066	0.071	-0.983	FA	7B
1098.75	021	-006	013	0.067	0.070	-0.983		
1100.00	021	-006	011	0.067	0.070	-0.983	FA	7B
1101.25	020	-006	010	0.067	0.070	-0.983		
1102.50	020	-006	008	0.067	0.070	-0.983	FA	7B
1103.75	019	-006	007	0.067	0.070	-0.983		
1105.00	019	-006	005	0.067	0.070	-0.983	FA	7B
1106.25	018	-007	004	0.067	0.070	-0.983		
1107.50	018	-007	002	0.067	0.070	-0.983	FA	7B
1108.75	017	-007	000	0.067	0.070	-0.983		
1110.00	017	-007	-001	0.067	0.070	-0.983	FA	7B
1111.25	016	-007	-002	0.067	0.070	-0.983		
1112.50	016	-007	-004	0.067	0.070	-0.983	FA	7B
1113.75	015	-008	-005	0.067	0.070	-0.983		
1115.00	015	-008	-007	0.067	0.070	-0.983	FA	7B
1116.25	014	-008	-008	0.067	0.070	-0.983		
1117.50	014	-008	-010	0.067	0.070	-0.983	FA	7B
1118.75	013	-008	-011	0.059	0.070	-0.983		
1120.00	013	-008	-013	0.059	0.070	-0.983	FA	7C
1121.25	012	-008	-014	0.059	0.070	-0.983		
1122.50	012	-009	-016	0.059	0.070	-0.983	FA	7C
1123.75	011	-009	-017	0.059	0.070	-0.983		
1125.00	011	-009	-019	0.059	0.070	-0.983	FA	7C

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1126.25	011	-009	-018	0.059	0.070	-0.983		
1127.50	012	-009	-017	0.059	0.070	-0.983	FA	7C
1128.75	012	-009	-016	0.059	0.070	-0.983		
1130.00	012	-010	-015	0.059	0.070	-0.983	FA	7C
1131.25	013	-010	-015	0.059	0.070	-0.983		
1132.50	013	-010	-014	0.059	0.070	-0.983	FA	7C
1133.75	013	-010	-013	0.059	0.070	-0.983		
1135.00	014	-010	-012	0.059	0.070	-0.983	FA	7C
1136.25	014	-010	-011	0.059	0.070	-0.983		
1137.50	014	-011	-011	0.059	0.070	-0.983	FA	7C
1138.75	015	-011	-010	0.059	0.070	-0.983		
1140.00	015	-011	-009	0.059	0.070	-0.983	FA	7C
1141.25	015	-011	-008	0.059	0.070	-0.983		
1142.50	016	-011	-007	0.059	0.070	-0.983	FA	7C
1143.75	016	-011	-006	0.059	0.070	-0.983		
1145.00	016	-011	-005	0.059	0.070	-0.983	FA	7C
1146.25	017	-011	-004	0.059	0.070	-0.983		
1147.50	017	-012	-004	0.059	0.070	-0.983	FA	7C
1148.75	018	-012	-003	0.059	0.070	-0.983		
1150.00	018	-012	-002	0.059	0.070	-0.983	FA	7C
1151.25	018	-012	-001	0.059	0.070	-0.983		
1152.50	019	-012	-000	0.059	0.070	-0.983	FA	7C
1153.75	019	-012	000	0.059	0.070	-0.983		
1155.00	019	-012	001	0.059	0.070	-0.983	FA	7C
1156.25	019	-012	002	0.059	0.070	-0.983		
1157.50	020	-012	003	0.059	0.070	-0.983	FA	7C
1158.75	020	-012	004	0.059	0.070	-0.983		
1160.00	020	-011	004	0.059	0.070	-0.983	FA	7C
1161.25	021	-011	005	0.060	0.069	-0.983		
1162.50	021	-011	006	0.060	0.069	-0.983	FA	7C
1163.75	021	-011	007	0.060	0.069	-0.983		
1165.00	021	-011	008	0.060	0.069	-0.983	FA	7C
1166.25	022	-011	009	0.052	0.069	-0.983		
1167.50	022	-011	009	0.052	0.069	-0.983	FA	7C
1168.75	022	-011	010	0.052	0.069	-0.983		
1170.00	023	-011	011	0.052	0.069	-0.983	FA	7C
1171.25	023	-011	011	0.052	0.069	-0.983		
1172.50	023	-011	012	0.052	0.069	-0.983	FA	7C
1173.75	024	-011	013	0.052	0.069	-0.983		
1175.00	024	-011	014	0.052	0.069	-0.983	FA	7C
1176.25	024	-011	014	0.052	0.069	-0.983		
1177.50	024	-011	014	0.052	0.069	-0.983	FA	7C
1178.75	024	-012	014	0.052	0.069	-0.983		
1180.00	024	-012	014	0.052	0.069	-0.983	FA	7C
1181.25	024	-012	014	0.052	0.069	-0.983		
1182.50	024	-012	014	0.053	0.069	-0.983	FA	7C
1183.75	024	-013	014	0.053	0.069	-0.983		
1185.00	024	-013	014	0.053	0.069	-0.983	FA	7C
1186.25	024	-013	014	0.053	0.069	-0.983		
1187.50	024	-013	014	0.053	0.069	-0.983	FA	7C
1188.75	024	-014	014	0.053	0.069	-0.983		
1190.00	024	-014	014	0.053	0.069	-0.983	FA	7C
1191.25	024	-014	015	0.053	0.069	-0.983		
1192.50	024	-014	015	0.053	0.069	-0.983	FA	7C
1193.75	024	-015	015	0.053	0.069	-0.983		
1195.00	024	-015	015	0.053	0.069	-0.983	FA	7C
1196.25	024	-015	015	0.053	0.069	-0.983		
1197.50	024	-015	015	0.053	0.061	-0.984	FB	7C
1198.75	024	-016	015	0.053	0.061	-0.984		
1200.00	024	-016	015	0.053	0.061	-0.984	FB	7C

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1201.25	024	-016	014	0.053	0.061	-0.984		
1202.50	024	-016	014	0.053	0.061	-0.984	FB	7D
1203.75	023	-017	013	0.053	0.061	-0.984		
1205.00	023	-017	013	0.045	0.061	-0.984	FB	7D
1206.25	023	-017	012	0.045	0.061	-0.984		
1207.50	023	-017	012	0.045	0.061	-0.984	FB	7D
1208.75	023	-018	011	0.045	0.061	-0.984		
1210.00	023	-018	011	0.045	0.061	-0.984	FB	7D
1211.25	022	-018	010	0.045	0.061	-0.984		
1212.50	022	-018	010	0.045	0.061	-0.984	FB	7D
1213.75	022	-019	009	0.045	0.061	-0.984		
1215.00	022	-019	008	0.045	0.061	-0.984	FB	7D
1216.25	022	-019	008	0.045	0.061	-0.984		
1217.50	022	-019	007	0.045	0.061	-0.984	FB	7D
1218.75	021	-020	007	0.045	0.061	-0.984		
1220.00	021	-020	006	0.045	0.061	-0.984	FB	7D
1221.25	021	-020	006	0.045	0.061	-0.984		
1222.50	021	-020	005	0.045	0.061	-0.984	FB	7D
1223.75	021	-021	004	0.045	0.061	-0.984		
1225.00	021	-021	004	0.045	0.061	-0.984	FB	7D
1226.25	021	-021	004	0.046	0.061	-0.984		
1227.50	021	-021	004	0.046	0.061	-0.984	FB	7D
1228.75	021	-022	004	0.046	0.061	-0.984		
1230.00	021	-022	004	0.038	0.061	-0.984	FB	7D
1231.25	021	-022	004	0.038	0.061	-0.984		
1232.50	021	-023	004	0.038	0.061	-0.984	FB	7D
1233.75	021	-023	004	0.038	0.061	-0.984		
1235.00	021	-023	003	0.038	0.061	-0.984	FB	7D
1236.25	021	-023	003	0.038	0.061	-0.984		
1237.50	021	-024	003	0.038	0.061	-0.984	FB	7D
1238.75	021	-024	003	0.038	0.061	-0.984		
1240.00	021	-024	003	0.038	0.061	-0.984	FB	7D
1241.25	021	-025	003	0.038	0.061	-0.984		
1242.50	021	-025	003	0.038	0.061	-0.984	FB	7D
1243.75	021	-025	003	0.038	0.061	-0.984		
1245.00	021	-026	003	0.038	0.061	-0.984	FB	7D
1246.25	021	-026	003	0.038	0.061	-0.984		
1247.50	021	-026	003	0.038	0.061	-0.984	FB	7D
1248.75	021	-027	003	0.038	0.061	-0.984		
1250.00	021	-027	003	0.038	0.061	-0.984	FB	7D
1251.25	021	-027	003	0.031	0.061	-0.985		
1252.50	021	-027	003	0.031	0.061	-0.985	FB	7E
1253.75	021	-028	003	0.031	0.061	-0.985		
1255.00	021	-028	003	0.031	0.061	-0.985	FB	7E
1256.25	021	-028	003	0.031	0.061	-0.985		
1257.50	021	-028	003	0.031	0.061	-0.985	FB	7E
1258.75	021	-029	004	0.031	0.061	-0.985		
1260.00	020	-029	004	0.031	0.061	-0.985	FB	7E
1261.25	020	-029	004	0.031	0.061	-0.985		
1262.50	020	-030	004	0.031	0.061	-0.985	FB	7E
1263.75	020	-030	004	0.031	0.061	-0.985		
1265.00	020	-030	004	0.031	0.061	-0.985	FB	7E
1266.25	020	-030	004	0.031	0.061	-0.985		
1267.50	020	-031	004	0.031	0.061	-0.985	FB	7E
1268.75	020	-031	004	0.023	0.061	-0.985		
1270.00	020	-031	004	0.023	0.061	-0.985	FB	7E
1271.25	020	-031	005	0.023	0.061	-0.985		
1272.50	020	-032	005	0.023	0.061	-0.985	FB	7E
1273.75	020	-032	005	0.023	0.061	-0.985		
1275.00	020	-032	005	0.023	0.060	-0.985	FB	7E

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1276.25	020	-032	005	0.023	0.060	-0.985		
1277.50	020	-032	005	0.023	0.060	-0.985	FB	7E
1278.75	021	-033	006	0.023	0.060	-0.985		
1280.00	021	-033	006	0.023	0.053	-0.985	FB	7E
1281.25	021	-033	006	0.023	0.053	-0.985		
1282.50	021	-034	006	0.023	0.053	-0.985	FB	7E
1283.75	021	-034	007	0.015	0.053	-0.985		
1285.00	021	-034	007	0.015	0.053	-0.985	FB	7F
1286.25	022	-035	007	0.015	0.053	-0.985		
1287.50	022	-035	007	0.015	0.053	-0.985	FB	7F
1288.75	022	-035	008	0.015	0.053	-0.985		
1290.00	022	-035	008	0.015	0.053	-0.985	FB	7F
1291.25	022	-036	008	0.015	0.053	-0.985		
1292.50	023	-036	008	0.015	0.053	-0.985	FB	7F
1293.75	023	-036	009	0.015	0.053	-0.985		
1295.00	023	-037	009	0.015	0.053	-0.985	FB	7F
1296.25	023	-037	009	0.015	0.053	-0.985		
1297.50	023	-037	009	0.008	0.053	-0.985	FB	7F
1298.75	024	-038	010	0.008	0.053	-0.985		
1300.00	024	-038	010	0.008	0.053	-0.985	FB	7F
1301.25	024	-038	011	0.008	0.053	-0.985		
1302.50	024	-038	011	0.008	0.053	-0.985	FB	7F
1303.75	024	-038	012	0.008	0.053	-0.985		
1305.00	024	-038	012	0.008	0.053	-0.985	FB	7F
1306.25	024	-038	013	0.008	0.053	-0.985		
1307.50	024	-038	013	0.008	0.053	-0.985	FB	7F
1308.75	024	-038	014	0.008	0.053	-0.985		
1310.00	024	-037	015	0.008	0.053	-0.985	FB	7F
1311.25	024	-037	015	0.000	0.053	-0.985		
1312.50	024	-037	016	0.000	0.053	-0.985	FB	7F
1313.75	024	-037	017	0.000	0.053	-0.985		
1315.00	024	-037	017	0.000	0.053	-0.985	FB	7F
1316.25	025	-037	018	0.000	0.053	-0.985		
1317.50	025	-037	018	0.000	0.053	-0.985	FB	7F
1318.75	025	-037	019	0.000	0.053	-0.985		
1320.00	025	-037	020	0.000	0.053	-0.985	FB	7F
1321.25	025	-037	020	0.000	0.053	-0.985		
1322.50	025	-037	021	0.000	0.053	-0.985	FB	7F
1323.75	025	-037	021	0.000	0.045	-0.985		
1325.00	025	-037	022	-0.007	0.045	-0.986	FC	80
1326.25	025	-037	022	-0.007	0.045	-0.986		
1327.50	024	-036	021	-0.007	0.045	-0.986	FC	80
1328.75	024	-036	021	-0.007	0.045	-0.986		
1330.00	024	-036	021	-0.007	0.045	-0.986	FC	80
1331.25	024	-036	021	-0.007	0.045	-0.986		
1332.50	024	-036	021	-0.007	0.045	-0.986	FC	80
1333.75	023	-035	021	-0.007	0.045	-0.986		
1335.00	023	-035	020	-0.007	0.045	-0.986	FC	80
1336.25	023	-035	020	-0.007	0.045	-0.986		
1337.50	023	-035	020	-0.007	0.045	-0.986	FC	80
1338.75	023	-035	020	-0.015	0.045	-0.986		
1340.00	022	-034	020	-0.015	0.045	-0.986	FC	80
1341.25	022	-034	019	-0.015	0.045	-0.986		
1342.50	022	-034	019	-0.015	0.045	-0.986	FC	80
1343.75	022	-034	019	-0.015	0.045	-0.986		
1345.00	021	-034	019	-0.015	0.045	-0.986	FC	80
1346.25	021	-033	019	-0.015	0.045	-0.986		
1347.50	021	-033	018	-0.015	0.037	-0.986	FC	80
1348.75	021	-033	018	-0.015	0.037	-0.986		
1350.00	021	-033	018	-0.015	0.037	-0.986	FC	80

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1201.25	024	-016	014	0.053	0.061	-0.984		
1202.50	024	-016	014	0.053	0.061	-0.984	FB	7D
1203.75	023	-017	013	0.053	0.061	-0.984		
1205.00	023	-017	013	0.045	0.061	-0.984	FB	7D
1206.25	023	-017	012	0.045	0.061	-0.984		
1207.50	023	-017	012	0.045	0.061	-0.984	FB	7D
1208.75	023	-018	011	0.045	0.061	-0.984		
1210.00	023	-018	011	0.045	0.061	-0.984	FB	7D
1211.25	022	-018	010	0.045	0.061	-0.984		
1212.50	022	-018	010	0.045	0.061	-0.984	FB	7D
1213.75	022	-019	009	0.045	0.061	-0.984		
1215.00	022	-019	008	0.045	0.061	-0.984	FB	7D
1216.25	022	-019	008	0.045	0.061	-0.984		
1217.50	022	-019	007	0.045	0.061	-0.984	FB	7D
1218.75	021	-020	007	0.045	0.061	-0.984		
1220.00	021	-020	006	0.045	0.061	-0.984	FB	7D
1221.25	021	-020	006	0.045	0.061	-0.984		
1222.50	021	-020	005	0.045	0.061	-0.984	FB	7D
1223.75	021	-021	004	0.045	0.061	-0.984		
1225.00	021	-021	004	0.045	0.061	-0.984	FB	7D
1226.25	021	-021	004	0.046	0.061	-0.984		
1227.50	021	-021	004	0.046	0.061	-0.984	FB	7D
1228.75	021	-022	004	0.046	0.061	-0.984		
1230.00	021	-022	004	0.038	0.061	-0.984	FB	7D
1231.25	021	-022	004	0.038	0.061	-0.984		
1232.50	021	-023	004	0.038	0.061	-0.984	FB	7D
1233.75	021	-023	004	0.038	0.061	-0.984		
1235.00	021	-023	003	0.038	0.061	-0.984	FB	7D
1236.25	021	-023	003	0.038	0.061	-0.984		
1237.50	021	-024	003	0.038	0.061	-0.984	FB	7D
1238.75	021	-024	003	0.038	0.061	-0.984		
1240.00	021	-024	003	0.038	0.061	-0.984	FB	7D
1241.25	021	-025	003	0.038	0.061	-0.984		
1242.50	021	-025	003	0.038	0.061	-0.984	FB	7D
1243.75	021	-025	003	0.038	0.061	-0.984		
1245.00	021	-026	003	0.038	0.061	-0.984	FB	7D
1246.25	021	-026	003	0.038	0.061	-0.984		
1247.50	021	-026	003	0.038	0.061	-0.984	FB	7D
1248.75	021	-027	003	0.038	0.061	-0.984		
1250.00	021	-027	003	0.038	0.061	-0.984	FB	7D
1251.25	021	-027	003	0.031	0.061	-0.985		
1252.50	021	-027	003	0.031	0.061	-0.985	FB	7E
1253.75	021	-028	003	0.031	0.061	-0.985		
1255.00	021	-028	003	0.031	0.061	-0.985	FB	7E
1256.25	021	-028	003	0.031	0.061	-0.985		
1257.50	021	-028	003	0.031	0.061	-0.985	FB	7E
1258.75	021	-029	004	0.031	0.061	-0.985		
1260.00	020	-029	004	0.031	0.061	-0.985	FB	7E
1261.25	020	-029	004	0.031	0.061	-0.985		
1262.50	020	-030	004	0.031	0.061	-0.985	FB	7E
1263.75	020	-030	004	0.031	0.061	-0.985		
1265.00	020	-030	004	0.031	0.061	-0.985	FB	7E
1266.25	020	-030	004	0.031	0.061	-0.985		
1267.50	020	-031	004	0.031	0.061	-0.985	FB	7E
1268.75	020	-031	004	0.023	0.061	-0.985		
1270.00	020	-031	004	0.023	0.061	-0.985	FB	7E
1271.25	020	-031	005	0.023	0.061	-0.985		
1272.50	020	-032	005	0.023	0.061	-0.985	FB	7E
1273.75	020	-032	005	0.023	0.061	-0.985		
1275.00	020	-032	005	0.023	0.060	-0.985	FB	7E

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1351.25	021	-033	018	-0.015	0.037	-0.986		
1352.50	021	-034	017	-0.015	0.037	-0.986	FC	80
1353.75	021	-034	017	-0.023	0.037	-0.986		
1355.00	021	-035	016	-0.023	0.037	-0.986	FC	81
1356.25	021	-035	016	-0.023	0.037	-0.986		
1357.50	021	-036	016	-0.023	0.037	-0.986	FC	81
1358.75	021	-036	015	-0.023	0.037	-0.986		
1360.00	022	-037	015	-0.023	0.037	-0.986	FC	81
1361.25	022	-037	015	-0.023	0.037	-0.986		
1362.50	022	-038	014	-0.023	0.037	-0.986	FC	81
1363.75	022	-039	014	-0.023	0.037	-0.986		
1365.00	022	-039	014	-0.023	0.037	-0.986	FC	81
1366.25	022	-040	013	-0.030	0.037	-0.985		
1367.50	022	-040	013	-0.030	0.037	-0.985	FC	81
1368.75	022	-041	013	-0.030	0.037	-0.985		
1370.00	022	-041	012	-0.030	0.037	-0.985	FC	81
1371.25	023	-042	012	-0.030	0.037	-0.985		
1372.50	023	-042	012	-0.030	0.037	-0.985	FC	81
1373.75	023	-043	011	-0.030	0.037	-0.985		
1375.00	023	-043	011	-0.030	0.037	-0.985	FC	81
1376.25	023	-043	011	-0.030	0.037	-0.985		
1377.50	023	-044	011	-0.030	0.037	-0.985	FC	81
1378.75	023	-045	012	-0.038	0.037	-0.985		
1380.00	024	-045	012	-0.038	0.037	-0.985	81	FB
1381.25	024	-046	012	-0.038	0.037	-0.985		
1382.50	024	-046	013	-0.038	0.030	-0.985	80	FB
1383.75	024	-047	013	-0.038	0.030	-0.985		
1385.00	024	-047	013	-0.038	0.030	-0.985	80	FB
1386.25	025	-048	014	-0.038	0.030	-0.985		
1387.50	025	-049	014	-0.038	0.030	-0.985	80	FB
1388.75	025	-049	014	-0.038	0.030	-0.985		
1390.00	025	-050	014	-0.046	0.030	-0.985	80	FB
1391.25	025	-050	015	-0.046	0.030	-0.985		
1392.50	026	-051	015	-0.046	0.030	-0.985	80	FB
1393.75	026	-051	015	-0.046	0.030	-0.985		
1395.00	026	-052	016	-0.046	0.030	-0.985	80	FB
1396.25	026	-052	016	-0.046	0.030	-0.985		
1397.50	026	-053	016	-0.046	0.030	-0.985	80	FB
1398.75	027	-053	017	-0.054	0.030	-0.985		
1400.00	027	-054	017	-0.054	0.030	-0.985	80	FA
1401.25	027	-055	017	-0.054	0.030	-0.985		
1402.50	027	-056	017	-0.054	0.030	-0.985	80	FA
1403.75	027	-057	017	-0.054	0.030	-0.985		
1405.00	027	-058	017	-0.054	0.030	-0.985	80	FA
1406.25	027	-058	017	-0.054	0.030	-0.985		
1407.50	027	-059	017	-0.054	0.030	-0.985	80	FA
1408.75	027	-060	017	-0.061	0.030	-0.984		
1410.00	027	-061	017	-0.061	0.030	-0.984	80	FA
1411.25	027	-062	017	-0.061	0.030	-0.984		
1412.50	027	-063	017	-0.061	0.030	-0.984	80	FA
1413.75	027	-064	017	-0.061	0.030	-0.984	80	FA
1415.00	027	-065	017	-0.061	0.023	-0.984	80	FA
1416.25	028	-065	018	-0.069	0.023	-0.984		
1417.50	028	-066	018	-0.069	0.023	-0.984	80	F9
1418.75	028	-067	018	-0.069	0.023	-0.984		
1420.00	028	-068	018	-0.069	0.023	-0.984	80	F9
1421.25	028	-069	018	-0.069	0.023	-0.984		
1422.50	028	-070	018	-0.069	0.023	-0.984	80	F9
1423.75	028	-071	018	-0.077	0.023	-0.983		
1425.00	028	-072	018	-0.077	0.023	-0.983	80	F9

T	R	O	P	DC1	DC2	DC3	RL.CODE	PC.CODE
1426.25	028	-073	018	-0.077	0.023	-0.983		
1427.50	028	-074	018	-0.077	0.023	-0.983	80	F4
1428.75	028	-074	018	-0.077	0.023	-0.983		
1430.00	028	-075	018	-0.084	0.023	-0.983	80	F8
1431.25	028	-076	018	-0.084	0.023	-0.983		
1432.50	028	-077	018	-0.084	0.023	-0.983	80	F8
1433.75	029	-078	019	-0.084	0.023	-0.983		
1435.00	029	-079	019	-0.084	0.023	-0.983	80	F8
1436.25	029	-080	019	-0.084	0.023	-0.983		
1437.50	029	-080	019	-0.092	0.023	-0.982	80	F8
1438.75	029	-081	019	-0.092	0.024	-0.982		
1440.00	029	-082	019	-0.092	0.024	-0.982	80	F8
1441.25	029	-083	019	-0.092	0.024	-0.982		
1442.50	029	-084	019	-0.092	0.016	-0.982	80	F7
1443.75	029	-085	019	-0.099	0.016	-0.981		
1445.00	029	-085	019	-0.099	0.016	-0.981	80	F7
1446.25	030	-086	020	-0.099	0.016	-0.981		
1447.50	030	-087	020	-0.099	0.016	-0.981	80	F7
1448.75	030	-088	020	-0.107	0.016	-0.980		
1450.00	030	-089	020	-0.107	0.016	-0.980	80	F7
1451.25	030	-090	020	-0.107	0.016	-0.980		
1452.50	030	-090	020	-0.107	0.016	-0.980	80	F7
1453.75	030	-091	020	-0.107	0.016	-0.980		
1455.00	030	-092	020	-0.115	0.016	-0.980	80	F6
1456.25	030	-092	020	-0.115	0.017	-0.980		
1457.50	030	-093	021	-0.115	0.017	-0.980	80	F6
1458.75	030	-094	021	-0.115	0.017	-0.980		
1460.00	030	-095	021	-0.122	0.017	-0.979	80	F6
1461.25	030	-095	021	-0.122	0.017	-0.979		
1462.50	030	-096	021	-0.122	0.017	-0.979	80	F6
1463.75	030	-096	021	-0.122	0.017	-0.979		
1465.00	030	-097	021	-0.130	0.017	-0.978	80	F5
1466.25	030	-098	021	-0.130	0.017	-0.978		
1467.50	030	-099	021	-0.130	0.010	-0.978	7F	F5
1468.75	030	-099	021	-0.130	0.010	-0.978		
1470.00	030	-100	021	-0.138	0.010	-0.977	7F	F5
1471.25	030	-101	022	-0.138	0.010	-0.977		
1472.50	030	-101	022	-0.138	0.011	-0.977	7F	F5
1473.75	030	-102	022	-0.138	0.011	-0.977		
1475.00	030	-103	022	-0.146	0.011	-0.976	7F	F4
1476.25	030	-104	022	-0.146	0.011	-0.976		
1477.50	030	-104	022	-0.146	0.011	-0.976	7F	F4
1478.75	030	-105	022	-0.146	0.011	-0.976		
1480.00	030	-106	022	-0.153	0.011	-0.974	7F	F4
1481.25	030	-107	022	-0.153	0.011	-0.974		
1482.50	031	-107	022	-0.153	0.011	-0.974	7F	F4
1483.75	031	-108	023	-0.153	0.011	-0.974		
1485.00	031	-109	023	-0.161	0.011	-0.973	7F	F3
1486.25	031	-110	023	-0.161	0.011	-0.973		
1487.50	031	-110	023	-0.161	0.011	-0.973	7F	F3
1488.75	031	-111	023	-0.169	0.011	-0.972		
1490.00	031	-112	023	-0.169	0.004	-0.972	7F	F3
1491.25	031	-113	023	-0.169	0.004	-0.972		
1492.50	031	-113	023	-0.169	0.004	-0.972	7F	F3
1493.75	032	-114	023	-0.176	0.004	-0.970		
1495.00	032	-115	023	-0.176	0.004	-0.970	7F	F3
1496.25	032	-116	024	-0.176	0.004	-0.970		
1497.50	032	-117	024	-0.184	0.004	-0.969	7F	F3
1498.75	032	-117	024	-0.184	0.004	-0.969		
1500.00	032	-118	024	-0.184	0.004	-0.969	7F	F3

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1351.25	021	-033	018	-0.015	0.037	-0.986		
1352.50	021	-034	017	-0.015	0.037	-0.986	FC	80
1353.75	021	-034	017	-0.023	0.037	-0.986		
1355.00	021	-035	016	-0.023	0.037	-0.986	FC	81
1356.25	021	-035	016	-0.023	0.037	-0.986		
1357.50	021	-036	016	-0.023	0.037	-0.986	FC	81
1358.75	021	-036	015	-0.023	0.037	-0.986		
1360.00	022	-037	015	-0.023	0.037	-0.986	FC	81
1361.25	022	-037	015	-0.023	0.037	-0.986		
1362.50	022	-038	014	-0.023	0.037	-0.986	FC	81
1363.75	022	-039	014	-0.023	0.037	-0.986		
1365.00	022	-039	014	-0.023	0.037	-0.986	FC	81
1366.25	022	-040	013	-0.030	0.037	-0.985		
1367.50	022	-040	013	-0.030	0.037	-0.985	FC	81
1368.75	022	-041	013	-0.030	0.037	-0.985		
1370.00	022	-041	012	-0.030	0.037	-0.985	FC	81
1371.25	023	-042	012	-0.030	0.037	-0.985		
1372.50	023	-042	012	-0.030	0.037	-0.985	FC	81
1373.75	023	-043	011	-0.030	0.037	-0.985		
1375.00	023	-043	011	-0.030	0.037	-0.985	FC	81
1376.25	023	-043	011	-0.030	0.037	-0.985		
1377.50	023	-044	011	-0.030	0.037	-0.985	FC	81
1378.75	023	-045	012	-0.038	0.037	-0.985		
1380.00	024	-045	012	-0.038	0.037	-0.985	81	FB
1381.25	024	-046	012	-0.038	0.037	-0.985		
1382.50	024	-046	013	-0.038	0.030	-0.985	80	FB
1383.75	024	-047	013	-0.038	0.030	-0.985		
1385.00	024	-047	013	-0.038	0.030	-0.985	80	FB
1386.25	025	-048	014	-0.038	0.030	-0.985		
1387.50	025	-049	014	-0.038	0.030	-0.985	80	FB
1388.75	025	-049	014	-0.038	0.030	-0.985		
1390.00	025	-050	014	-0.046	0.030	-0.985	80	FB
1391.25	025	-050	015	-0.046	0.030	-0.985		
1392.50	026	-051	015	-0.046	0.030	-0.985	80	FB
1393.75	026	-051	015	-0.046	0.030	-0.985		
1395.00	026	-052	016	-0.046	0.030	-0.985	80	FB
1396.25	026	-052	016	-0.046	0.030	-0.985		
1397.50	026	-053	016	-0.046	0.030	-0.985	80	FB
1398.75	027	-053	017	-0.054	0.030	-0.985		
1400.00	027	-054	017	-0.054	0.030	-0.985	80	FA
1401.25	027	-055	017	-0.054	0.030	-0.985		
1402.50	027	-056	017	-0.054	0.030	-0.985	80	FA
1403.75	027	-057	017	-0.054	0.030	-0.985		
1405.00	027	-058	017	-0.054	0.030	-0.985	80	FA
1406.25	027	-058	017	-0.054	0.030	-0.985		
1407.50	027	-059	017	-0.054	0.030	-0.985	80	FA
1408.75	027	-060	017	-0.061	0.030	-0.984		
1410.00	027	-061	017	-0.061	0.030	-0.984	80	FA
1411.25	027	-062	017	-0.061	0.030	-0.984		
1412.50	027	-063	017	-0.061	0.030	-0.984	80	FA
1413.75	027	-064	017	-0.061	0.030	-0.984		
1415.00	027	-065	017	-0.061	0.023	-0.984	80	FA
1416.25	028	-065	018	-0.069	0.023	-0.984		
1417.50	028	-066	018	-0.069	0.023	-0.984	80	FA
1418.75	028	-067	018	-0.069	0.023	-0.984		
1420.00	028	-068	018	-0.069	0.023	-0.984	80	FA
1421.25	028	-069	018	-0.069	0.023	-0.984		
1422.50	028	-070	018	-0.069	0.023	-0.984	80	FA
1423.75	028	-071	018	-0.077	0.023	-0.983		
1425.00	028	-072	018	-0.077	0.023	-0.983	80	FA

T	R	O	P	DC1	DC2	DC3	RL.CMD	PC.CMD
1426.25	028	-073	016	-0.077	0.023	-0.983		
1427.50	028	-074	018	-0.077	0.023	-0.983	80	
1428.75	028	-074	018	-0.077	0.023	-0.983		
1430.00	028	-075	018	-0.084	0.023	-0.983	80	
1431.25	028	-076	018	-0.084	0.023	-0.983		
1432.50	028	-077	018	-0.084	0.023	-0.983	80	
1433.75	029	-078	019	-0.084	0.023	-0.983		
1435.00	029	-079	019	-0.084	0.023	-0.983	80	
1436.25	029	-080	019	-0.084	0.023	-0.983		
1437.50	029	-080	019	-0.092	0.023	-0.982	80	
1438.75	029	-081	019	-0.092	0.024	-0.982		
1440.00	029	-082	019	-0.092	0.024	-0.982	80	F2
1441.25	029	-083	019	-0.092	0.024	-0.982		
1442.50	029	-084	019	-0.092	0.016	-0.982	80	
1443.75	029	-085	019	-0.099	0.016	-0.981		
1445.00	029	-085	019	-0.099	0.016	-0.981	80	F7
1446.25	030	-086	020	-0.099	0.016	-0.981		
1447.50	030	-087	020	-0.099	0.016	-0.981	80	F7
1448.75	030	-088	020	-0.107	0.016	-0.980		
1450.00	030	-089	020	-0.107	0.016	-0.980	80	F7
1451.25	030	-090	020	-0.107	0.016	-0.980		
1452.50	030	-090	020	-0.107	0.016	-0.980	80	F7
1453.75	030	-091	020	-0.107	0.016	-0.980		
1455.00	030	-092	020	-0.115	0.016	-0.980	80	F6
1456.25	030	-092	020	-0.115	0.017	-0.980		
1457.50	030	-093	021	-0.115	0.017	-0.980	80	F6
1458.75	030	-094	021	-0.115	0.017	-0.980		
1460.00	030	-095	021	-0.122	0.017	-0.979	80	F6
1461.25	030	-095	021	-0.122	0.017	-0.979		
1462.50	030	-096	021	-0.122	0.017	-0.979	80	F6
1463.75	030	-096	021	-0.122	0.017	-0.979		
1465.00	030	-097	021	-0.130	0.017	-0.978	80	F5
1466.25	030	-098	021	-0.130	0.017	-0.978		
1467.50	030	-099	021	-0.130	0.010	-0.978	7F	F5
1468.75	030	-099	021	-0.130	0.010	-0.978		
1470.00	030	-100	021	-0.138	0.010	-0.977	7F	F5
1471.25	030	-101	022	-0.138	0.010	-0.977		
1472.50	030	-101	022	-0.138	0.011	-0.977	7F	F5
1473.75	030	-102	022	-0.138	0.011	-0.977		
1475.00	030	-103	022	-0.146	0.011	-0.976	7F	F4
1476.25	030	-104	022	-0.146	0.011	-0.976		
1477.50	030	-104	022	-0.146	0.011	-0.976	7F	F4
1478.75	030	-105	022	-0.146	0.011	-0.976		
1480.00	030	-106	022	-0.153	0.011	-0.974	7F	F4
1481.25	030	-107	022	-0.153	0.011	-0.974		
1482.50	031	-107	022	-0.153	0.011	-0.974	7F	F4
1483.75	031	-108	023	-0.153	0.011	-0.974		
1485.00	031	-109	023	-0.161	0.011	-0.973	7F	F3
1486.25	031	-110	023	-0.161	0.011	-0.973		
1487.50	031	-110	023	-0.161	0.011	-0.973	7F	F3
1488.75	031	-111	023	-0.169	0.011	-0.972		
1490.00	031	-112	023	-0.169	0.004	-0.972	7F	
1491.25	031	-113	023	-0.169	0.004	-0.972		
1492.50	031	-113	023	-0.169	0.004	-0.972	7F	F3
1493.75	032	-114	023	-0.176	0.004	-0.970		
1495.00	032	-115	023	-0.176	0.004	-0.970	7F	
1496.25	032	-116	024	-0.176	0.004	-0.970		
1497.50	032	-117	024	-0.184	0.004	-0.969	7F	
1498.75	032	-117	024	-0.184	0.004	-0.969		
1500.00	032	-118	024	-0.184	0.004	-0.969	7F	

A.2 Vertical Seeking Maneuver - 180° Roll Test

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0.00	0	0	0	0.000	0.000	1.000		
0001.25	-000	000	000	0.000	0.000	1.000		
0002.50	-001	000	000	0.000	0.000	1.000	7F	7F
0003.75	-001	000	000	0.000	0.000	1.000		
0005.00	-001	001	000	0.000	0.000	1.000	7F	7F
0006.25	-002	001	000	0.000	0.000	1.000		
0007.50	-002	001	000	0.000	0.000	1.000	7F	7F
0008.75	-002	001	001	0.000	0.000	1.000		
0010.00	-003	001	001	0.000	0.000	1.000	7F	7F
0011.25	-003	002	001	0.000	0.000	1.000		
0012.50	-003	002	001	0.000	0.000	1.000	7F	7F
0013.75	-004	002	001	0.000	0.000	1.000		
0015.00	-004	002	001	0.000	0.000	1.000	7F	7F
0016.25	-004	002	001	0.000	0.000	1.000		
0017.50	-005	003	001	0.000	0.000	1.000	7F	7F
0018.75	-005	003	001	0.000	0.000	1.000		
0020.00	-005	003	001	0.000	0.000	1.000	7F	7F
0021.25	-006	003	002	0.000	0.000	1.000		
0022.50	-006	003	002	0.000	0.000	1.000	7F	7F
0023.75	-007	004	002	0.000	0.000	1.000		
0025.00	-007	004	002	0.000	0.000	1.000	7F	7F
0026.25	-007	004	003	0.000	0.000	1.000		
0027.50	-007	004	005	0.000	0.000	1.000	7F	7F
0028.75	-007	004	006	0.000	0.000	1.000		
0030.00	-007	005	008	0.000	0.000	1.000	7F	7F
0031.25	-007	005	009	0.000	0.000	1.000		
0032.50	-007	005	010	0.000	0.000	1.000	7F	7F
0033.75	-007	005	012	0.000	0.000	1.000		
0035.00	-007	005	013	0.000	0.000	1.000	7F	7F
0036.25	-007	006	014	0.000	0.000	1.000		
0037.50	-007	006	016	0.000	0.000	1.000	7F	7F
0038.75	-007	006	017	0.000	0.000	1.000		
0040.00	-007	006	019	0.000	0.000	1.000	7F	7F
0041.25	-007	006	020	0.000	0.000	1.000		
0042.50	-007	007	021	0.000	0.000	1.000	7F	7F
0043.75	-007	007	023	0.000	0.000	1.000		
0045.00	-007	007	024	0.000	0.000	1.000	7F	7F
0046.25	-007	007	026	0.000	0.000	1.000		
0047.50	-007	007	027	0.000	0.000	1.000	7F	7F
0048.75	-007	008	028	0.000	0.000	1.000		
0050.00	-007	008	030	0.000	0.000	1.000	7F	7F
0051.25	-006	008	033	0.000	0.000	1.000		
0052.50	-005	008	036	0.000	0.000	1.000	7F	7F
0053.75	-004	008	039	0.000	0.008	1.000		
0055.00	-003	009	042	0.000	0.008	1.000	7F	7F
0056.25	-002	009	045	0.000	0.008	1.000		
0057.50	-001	009	048	0.000	0.008	1.000	7F	7F
0058.75	-000	009	051	0.000	0.008	1.000		
0060.00	001	009	054	0.000	0.008	1.000	7F	7F
0061.25	002	009	057	0.000	0.008	1.000		
0062.50	003	010	060	0.000	0.008	1.000	7F	7F
0063.75	003	010	064	0.000	0.016	1.000		
0065.00	004	010	066	0.000	0.016	1.000	80	7F
0066.25	005	010	070	0.000	0.016	1.000		
0067.50	006	010	073	0.000	0.016	1.000	80	7F
0068.75	007	010	076	0.000	0.016	1.000		
0070.00	008	010	079	0.000	0.016	1.000	80	7F
0071.25	009	011	082	0.000	0.023	1.000		
0072.50	010	011	085	0.000	0.023	1.000	80	7F
0073.75	011	011	088	0.000	0.023	1.000		
0075.00	012	011	091	0.000	0.023	1.000	80	7F

T	R	Q	P	DC1	DC2	DC3	RL.CMD	PC.CMD
0076.25	013	011	094	0.000	0.023	1.000		
0077.50	014	011	097	0.000	0.031	1.000	80	7F
0078.75	015	011	100	0.000	0.031	1.000		
0080.00	016	012	103	0.000	0.031	1.000	80	7F
0081.25	017	012	106	0.000	0.031	1.000		
0082.50	018	012	109	-0.008	0.039	1.000	81	80
0083.75	019	012	113	-0.008	0.039	1.000		
0085.00	020	012	116	-0.008	0.039	1.000	81	80
0086.25	021	013	119	-0.008	0.046	0.999		
0087.50	022	013	122	-0.008	0.046	0.999	81	80
0088.75	023	013	125	-0.008	0.046	0.999		
0090.00	024	013	128	-0.008	0.054	0.999	82	80
0091.25	025	013	131	-0.008	0.054	0.999		
0092.50	026	014	134	-0.008	0.054	0.999	82	80
0093.75	027	014	138	-0.008	0.062	0.999		
0095.00	028	014	140	-0.008	0.062	0.999	82	80
0096.25	029	014	144	-0.008	0.062	0.999		
0097.50	030	014	147	-0.008	0.069	0.998	83	80
0098.75	031	015	150	-0.008	0.069	0.998		
0100.00	032	015	153	-0.008	0.069	0.998	83	80
0101.25	033	015	156	-0.008	0.077	0.998		
0102.50	034	015	159	-0.008	0.077	0.998	83	80
0103.75	035	015	162	-0.008	0.077	0.998		
0105.00	036	015	166	-0.007	0.085	0.997	84	80
0106.25	037	016	169	-0.007	0.085	0.997		
0107.50	038	016	172	-0.007	0.093	0.997	84	80
0108.75	039	016	175	-0.007	0.093	0.997		
0110.00	040	016	179	-0.007	0.100	0.996	85	80
0111.25	041	016	182	-0.007	0.100	0.996		
0112.50	042	016	185	-0.007	0.108	0.995	85	80
0113.75	043	017	188	-0.007	0.108	0.995		
0115.00	044	017	191	-0.007	0.108	0.995	85	80
0116.25	045	017	194	-0.015	0.116	0.995		
0117.50	046	017	198	-0.014	0.116	0.995	85	80
0118.75	047	017	201	-0.014	0.124	0.994		
0120.00	048	017	204	-0.014	0.124	0.994	86	80
0121.25	049	017	207	-0.014	0.131	0.993		
0122.50	050	018	211	-0.014	0.131	0.993	87	80
0123.75	051	018	214	-0.014	0.139	0.992		
0125.00	052	018	217	-0.014	0.147	0.991	88	80
0126.25	053	017	221	-0.014	0.147	0.991		
0127.50	054	017	225	-0.013	0.154	0.990	88	80
0128.75	055	016	229	-0.013	0.154	0.990		
0130.00	056	016	233	-0.013	0.162	0.989	89	80
0131.25	057	016	237	-0.013	0.162	0.989		
0132.50	058	015	242	-0.013	0.170	0.988	89	80
0133.75	059	015	246	-0.013	0.177	0.986		
0135.00	060	014	250	-0.013	0.177	0.986	8A	80
0136.25	061	014	254	-0.012	0.185	0.985		
0137.50	062	013	258	-0.012	0.185	0.985	8A	80
0138.75	063	013	262	-0.012	0.193	0.984		
0140.00	064	012	266	-0.012	0.200	0.982	8B	80
0141.25	065	012	270	-0.012	0.200	0.982		
0142.50	066	011	274	-0.012	0.208	0.981	8C	80
0143.75	067	011	278	-0.010	0.216	0.979		
0145.00	068	011	283	-0.010	0.216	0.979	8C	80
0146.25	069	010	287	-0.010	0.223	0.978		
0147.50	070	010	291	-0.010	0.231	0.976	8D	80
0148.75	071	009	295	-0.010	0.238	0.974		
0150.00	072	009	299	-0.010	0.238	0.974	8E	80

T	R	Q	P	DC1	DC2	DC3	RL.CMD	PC.CMD

T	R	O	P	DC1	DC2	DC3	BL.CMND	PC.
0151.25	073	008	302	-0.016	0.246	0.972		
0152.50	074	008	306	-0.016	0.254	0.970	8F	1
0153.75	075	007	309	-0.016	0.261	0.968		
0155.00	076	007	312	-0.016	0.261	0.968	8F	81
0156.25	077	006	315	-0.016	0.269	0.966		
0157.50	078	006	319	-0.016	0.276	0.964	90	81
0158.75	079	005	322	-0.014	0.284	0.962		
0160.00	080	004	325	-0.014	0.291	0.960	91	80
0161.25	081	004	328	-0.014	0.291	0.960		
0162.50	082	003	331	-0.014	0.299	0.958	92	80
0163.75	083	003	335	-0.014	0.306	0.956		
0165.00	084	002	338	-0.011	0.314	0.953	93	80
0166.25	085	002	341	-0.011	0.321	0.951		
0167.50	086	001	344	-0.011	0.328	0.948	94	80
0168.75	087	001	348	-0.011	0.328	0.948		
0170.00	088	000	351	-0.009	0.336	0.946	94	80
0171.25	089	-000	354	-0.009	0.343	0.943		
0172.50	090	-001	357	-0.009	0.350	0.941	95	80
0173.75	091	-001	361	-0.009	0.358	0.938		
0175.00	092	-002	364	-0.009	0.365	0.935	96	80
0176.25	093	-002	367	-0.006	0.372	0.932		
0177.50	094	-003	369	-0.006	0.379	0.930	97	80
0178.75	095	-003	372	-0.006	0.387	0.927		
0180.00	096	-004	374	-0.006	0.394	0.924	98	80
0181.25	097	-004	377	-0.003	0.401	0.921		
0182.50	098	-005	380	-0.003	0.401	0.921	98	80
0183.75	099	-005	383	-0.003	0.408	0.918		
0185.00	100	-006	385	-0.003	0.415	0.915	99	80
0186.25	101	-006	388	0.000	0.422	0.911		
0187.50	102	-007	391	0.000	0.429	0.908	9A	7F
0188.75	103	-008	393	0.000	0.436	0.905		
0190.00	104	-008	396	0.000	0.443	0.901	9B	7F
0191.25	105	-009	398	0.004	0.450	0.898		
0192.50	106	-009	401	0.004	0.457	0.895	9C	7F
0193.75	107	-010	404	0.004	0.464	0.891		
0195.00	108	-010	406	0.004	0.471	0.888	9D	7F
0196.25	109	-011	409	0.007	0.478	0.884		
0197.50	110	-011	412	0.007	0.485	0.880	9E	7F
0198.75	111	-011	414	0.007	0.492	0.876		
0200.00	112	-012	417	0.007	0.498	0.873	9E	7F
0201.25	112	-012	415	0.011	0.505	0.869		
0202.50	111	-013	413	0.011	0.512	0.865	9F	7F
0203.75	111	-013	411	0.011	0.518	0.861		
0205.00	111	-014	409	0.015	0.525	0.857	A0	7F
0206.25	111	-014	407	0.015	0.532	0.853		
0207.50	111	-015	405	0.015	0.538	0.849	A1	7F
0208.75	110	-015	403	0.015	0.545	0.845		
0210.00	110	-016	401	0.019	0.551	0.841	A2	7E
0211.25	110	-016	399	0.019	0.558	0.836		
0212.50	110	-017	397	0.019	0.564	0.832	A3	7E
0213.75	110	-018	395	0.024	0.570	0.828		
0215.00	109	-018	394	0.024	0.577	0.823	A3	7E
0216.25	109	-019	392	0.024	0.583	0.819		
0217.50	109	-019	390	0.024	0.589	0.814	A4	7E
0218.75	109	-020	388	0.028	0.596	0.810		
0220.00	109	-020	386	0.028	0.602	0.805	A5	7E
0221.25	108	-021	384	0.028	0.608	0.801		
0222.50	108	-021	382	0.028	0.614	0.796	A6	7E
0223.75	108	-021	380	0.033	0.620	0.791		
0225.00	108	-022	378	0.033	0.626	0.786	A7	7E

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0226.25	108	-022	376	0.039	0.632	0.781		
0227.50	107	-023	374	0.044	0.638	0.776	A7	7D
0228.75	107	-024	372	0.044	0.644	0.771		
0230.00	106	-024	370	0.044	0.650	0.766	A8	7D
0231.25	106	-025	368	0.044	0.656	0.761		
0232.50	106	-025	366	0.049	0.661	0.756	A9	7C
0233.75	106	-025	364	0.049	0.667	0.751		
0235.00	105	-026	362	0.049	0.673	0.746	AA	7C
0236.25	105	-027	360	0.049	0.679	0.741		
0237.50	105	-028	358	0.054	0.684	0.736	AA	7C
0238.75	104	-028	356	0.054	0.690	0.730		
0240.00	104	-029	354	0.054	0.690	0.730	AB	7C
0241.25	103	-029	352	0.054	0.695	0.725		
0242.50	103	-030	350	0.060	0.701	0.720	AB	7C
0243.75	103	-030	348	0.060	0.706	0.714		
0245.00	102	-031	346	0.065	0.712	0.708	AC	7B
0246.25	102	-031	344	0.071	0.717	0.703		
0247.50	102	-032	342	0.071	0.722	0.698	AD	7B
0248.75	101	-032	340	0.071	0.727	0.692		
0250.00	101	-033	338	0.071	0.727	0.692	AD	73
0251.25	101	-033	338	0.076	0.732	0.686		
0252.50	101	-034	338	0.076	0.737	0.681	AE	7B
0253.75	101	-035	339	0.076	0.743	0.675		
0255.00	101	-035	339	0.076	0.748	0.669	AE	7B
0256.25	101	-036	339	0.082	0.752	0.663		
0257.50	101	-036	339	0.082	0.752	0.663	AF	7A
0258.75	101	-037	339	0.082	0.757	0.658		
0260.00	100	-037	340	0.087	0.762	0.651	AF	7A
0261.25	100	-038	340	0.093	0.767	0.645		
0262.50	100	-039	340	0.093	0.772	0.639	B0	7A
0263.75	100	-039	340	0.093	0.777	0.633		
0265.00	100	-040	340	0.093	0.781	0.627	B1	7A
0266.25	100	-040	340	0.099	0.781	0.627		
0267.50	100	-041	341	0.099	0.786	0.621	B1	79
0268.75	100	-041	341	0.099	0.790	0.615		
0270.00	100	-042	341	0.099	0.795	0.609	B1	79
0271.25	100	-042	341	0.105	0.799	0.603		
0272.50	100	-043	341	0.109	0.804	0.596	B2	73
0273.75	100	-043	342	0.109	0.808	0.590		
0275.00	100	-044	342	0.109	0.808	0.590	B2	73
0276.25	100	-044	343	0.116	0.812	0.584		
0277.50	101	-045	343	0.116	0.816	0.577	B3	78
0278.75	101	-046	344	0.116	0.821	0.571		
0280.00	102	-046	345	0.116	0.825	0.565	B3	78
0281.25	102	-047	345	0.122	0.828	0.558		
0282.50	103	-048	346	0.122	0.833	0.552	B4	78
0283.75	103	-048	347	0.126	0.833	0.551		
0285.00	104	-049	347	0.126	0.837	0.545	B4	77
0286.25	104	-049	348	0.133	0.840	0.538		
0287.50	105	-050	349	0.133	0.844	0.532	B5	77
0288.75	106	-051	349	0.133	0.848	0.525		
0290.00	106	-051	350	0.133	0.852	0.518	B5	77
0291.25	106	-052	350	0.139	0.855	0.512		
0292.50	107	-052	351	0.139	0.859	0.505	B6	77
0293.75	107	-053	352	0.143	0.859	0.504		
0295.00	108	-053	352	0.143	0.863	0.498	B6	76
0296.25	108	-054	353	0.150	0.866	0.491		
0297.50	109	-055	354	0.150	0.869	0.484	B6	76
0298.75	109	-055	354	0.150	0.873	0.478		
0300.00	110	-056	355	0.157	0.875	0.471	B7	75

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC....
0301.25	110	-056	353	0.157	0.879	0.464		
0302.50	110	-057	351	0.160	0.882	0.456	B7	75
0303.75	110	-057	349	0.160	0.886	0.449		
0305.00	109	-058	348	0.167	0.885	0.449	B7	75
0306.25	109	-058	346	0.167	0.888	0.442		
0307.50	109	-059	344	0.167	0.891	0.435	B8	75
0308.75	109	-059	342	0.167	0.895	0.428		
0310.00	109	-060	340	0.174	0.897	0.422	B8	74
0311.25	109	-060	338	0.177	0.900	0.413		
0312.50	109	-061	336	0.177	0.903	0.406	B8	74
0313.75	109	-062	334	0.184	0.902	0.406		
0315.00	109	-062	333	0.184	0.905	0.399	B8	74
0316.25	109	-063	331	0.184	0.908	0.392		
0317.50	108	-063	329	0.184	0.911	0.385	B9	74
0318.75	108	-064	327	0.194	0.912	0.377		
0320.00	108	-064	325	0.194	0.915	0.370	B9	73
0321.25	108	-064	323	0.194	0.915	0.370		
0322.50	108	-065	321	0.194	0.918	0.363	B9	73
0323.75	108	-065	320	0.201	0.919	0.356		
0325.00	108	-066	318	0.201	0.922	0.349	B9	73
0326.25	107	-067	316	0.201	0.924	0.341		
0327.50	107	-067	314	0.211	0.923	0.340	BA	72
0328.75	107	-068	312	0.211	0.925	0.333		
0330.00	106	-069	310	0.211	0.928	0.326	BA	72
0331.25	106	-070	309	0.211	0.930	0.318		
0332.50	106	-070	307	0.218	0.931	0.311	BA	72
0333.75	105	-071	305	0.221	0.931	0.310		
0335.00	105	-072	303	0.221	0.933	0.302	BA	71
0336.25	104	-073	301	0.221	0.936	0.295		
0337.50	104	-074	299	0.228	0.936	0.288	BA	71
0338.75	104	-074	298	0.228	0.936	0.288		
0340.00	103	-075	296	0.228	0.938	0.281	BB	71
0341.25	103	-076	294	0.230	0.940	0.272		
0342.50	102	-076	292	0.237	0.940	0.264	BB	70
0343.75	102	-077	290	0.237	0.940	0.264		
0345.00	102	-078	288	0.237	0.942	0.257	BB	70
0346.25	101	-079	287	0.237	0.944	0.250		
0347.50	101	-079	285	0.246	0.942	0.248	BB	70
0348.75	100	-080	283	0.246	0.944	0.241		
0350.00	100	-081	281	0.246	0.946	0.233	BB	70
0351.25	100	-082	282	0.246	0.948	0.226		
0352.50	101	-083	284	0.254	0.946	0.226	BB	6F
0353.75	101	-083	285	0.255	0.947	0.217		
0355.00	102	-084	287	0.255	0.949	0.209	BB	6F
0356.25	102	-085	288	0.263	0.947	0.209		
0357.50	103	-086	289	0.263	0.948	0.202	BB	6F
0358.75	103	-086	291	0.263	0.950	0.195		
0360.00	104	-087	292	0.264	0.951	0.185	BB	6F
0361.25	104	-088	294	0.271	0.949	0.185		
0362.50	105	-089	295	0.271	0.951	0.178	BB	6E
0363.75	105	-090	296	0.271	0.952	0.171		
0365.00	105	-091	298	0.272	0.953	0.161	BC	6E
0366.25	106	-091	299	0.280	0.951	0.161		
0367.50	106	-092	301	0.280	0.952	0.154	BB	6E
0368.75	107	-093	302	0.280	0.953	0.147		
0370.00	107	-094	303	0.280	0.954	0.139	BC	6E
0371.25	107	-095	305	0.288	0.952	0.137		
0372.50	108	-095	306	0.288	0.953	0.130	BC	6D
0373.75	108	-096	308	0.288	0.954	0.122		
0375.00	109	-097	309	0.288	0.955	0.115	BC	6D

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0376.25	110	-097	309	0.296	0.953	0.113		
0377.50	111	-098	309	0.296	0.953	0.105	BC	6D
0378.75	112	-099	309	0.296	0.954	0.098		
0380.00	114	-099	308	0.304	0.953	0.091	BB	6C
0381.25	115	-100	308	0.304	0.953	0.081		
0382.50	116	-100	308	0.304	0.953	0.081	BC	6C
0383.75	117	-101	308	0.304	0.954	0.074		
0385.00	118	-101	308	0.312	0.952	0.066	BB	6C
0386.25	119	-102	308	0.312	0.952	0.057		
0387.50	120	-103	308	0.312	0.952	0.057	BB	6C
0388.75	122	-103	307	0.319	0.950	0.049		
0390.00	123	-104	307	0.319	0.950	0.042	BB	6B
0391.25	124	-104	307	0.319	0.951	0.032		
0392.50	125	-105	307	0.327	0.948	0.032	BB	6B
0393.75	126	-105	307	0.327	0.948	0.025		
0395.00	127	-106	307	0.327	0.948	0.018	BB	6B
0396.25	128	-106	306	0.334	0.946	0.008		
0397.50	130	-107	306	0.334	0.946	0.000	BB	6A
0398.75	131	-107	306	0.334	0.946	0.000		
0400.00	132	-108	306	0.334	0.946	-0.009	C2	6A
0401.25	131	-108	303	0.341	0.943	-0.017		
0402.50	130	-109	301	0.341	0.943	-0.024	C2	6A
0403.75	130	-109	298	0.341	0.943	-0.024		
0405.00	129	-109	296	0.348	0.940	-0.034	C2	69
0406.25	128	-110	294	0.348	0.940	-0.041		
0407.50	127	-110	291	0.348	0.939	-0.049	C2	69
0408.75	127	-110	289	0.355	0.936	-0.049		
0410.00	126	-111	286	0.355	0.936	-0.058	C3	69
0411.25	125	-111	284	0.355	0.935	-0.066		
0412.50	124	-111	281	0.362	0.933	-0.066	C3	68
0413.75	124	-112	279	0.362	0.932	-0.076		
0415.00	123	-112	277	0.362	0.931	-0.083	C3	68
0416.25	122	-112	274	0.369	0.928	-0.090		
0417.50	121	-113	272	0.369	0.928	-0.090	C3	68
0418.75	121	-113	269	0.368	0.927	-0.100		
0420.00	120	-113	267	0.375	0.923	-0.107	C3	67
0421.25	119	-114	264	0.375	0.923	-0.107		
0422.50	118	-114	262	0.374	0.922	-0.117	C3	68
0423.75	117	-115	259	0.374	0.921	-0.125		
0425.00	117	-115	257	0.381	0.918	-0.125	C4	67
0426.25	117	-115	256	0.381	0.917	-0.132		
0427.50	116	-116	255	0.380	0.916	-0.142	C4	67
0428.75	116	-117	254	0.387	0.913	-0.142		
0430.00	116	-117	253	0.387	0.912	-0.149	C4	67
0431.25	116	-118	252	0.386	0.912	-0.152		
0432.50	115	-118	250	0.386	0.911	-0.159	C4	67
0433.75	115	-119	249	0.393	0.908	-0.166		
0435.00	115	-119	248	0.393	0.908	-0.166	C4	66
0436.25	115	-120	247	0.391	0.905	-0.176		
0437.50	114	-120	246	0.393	0.900	-0.183	C5	66
0438.75	114	-121	245	0.393	0.900	-0.183		
0440.00	114	-122	244	0.397	0.899	-0.193	C5	66
0441.25	114	-122	243	0.404	0.896	-0.193		
0442.50	113	-123	242	0.404	0.894	-0.200	C5	66
0443.75	113	-123	241	0.402	0.892	-0.210		
0445.00	113	-124	239	0.402	0.890	-0.210	C5	66
0446.25	113	-124	238	0.409	0.888	-0.217		
0447.50	112	-125	237	0.407	0.888	-0.220	C6	65
0448.75	112	-126	236	0.407	0.886	-0.227		
0450.00	112	-126	235	0.407	0.884	-0.234	C6	65

T	R	O	P	DC1	DC2	DC3	RL.CMND	RC.CMND
0451.25	112	-127	236	0.414	0.881	-0.234		
0452.50	113	-127	237	0.412	0.879	-0.244	C6	65
0453.75	114	-127	239	0.412	0.879	-0.244		
0455.00	114	-128	240	0.419	0.874	-0.250	C7	65
0456.25	115	-128	241	0.417	0.872	-0.260		
0457.50	115	-129	242	0.417	0.872	-0.260	C7	65
0458.75	116	-129	243	0.417	0.869	-0.267		
0460.00	116	-129	245	0.421	0.866	-0.270	C7	65
0461.25	117	-130	246	0.421	0.864	-0.277		
0462.50	117	-130	247	0.421	0.862	-0.284	C7	65
0463.75	118	-131	248	0.426	0.859	-0.287		
0465.00	118	-131	249	0.426	0.856	-0.293	C8	64
0466.25	119	-132	251	0.426	0.854	-0.300		
0467.50	120	-132	252	0.430	0.850	-0.303	C8	64
0468.75	120	-133	253	0.430	0.848	-0.310		
0470.00	121	-133	254	0.430	0.848	-0.310	C8	64
0471.25	121	-134	255	0.427	0.845	-0.320		
0472.50	122	-134	256	0.434	0.840	-0.326	C9	64
0473.75	122	-134	258	0.434	0.840	-0.326		
0475.00	123	-135	259	0.431	0.837	-0.336	C9	64
0476.25	123	-135	257	0.437	0.831	-0.343		
0477.50	123	-135	255	0.437	0.831	-0.343	C9	64
0478.75	123	-134	252	0.435	0.828	-0.352		
0480.00	123	-134	250	0.441	0.822	-0.359	CA	63
0481.25	123	-134	248	0.441	0.822	-0.359		
0482.50	123	-134	246	0.438	0.819	-0.368	CA	63
0483.75	123	-134	244	0.444	0.816	-0.368		
0485.00	122	-134	241	0.444	0.813	-0.375	CA	63
0486.25	122	-134	239	0.441	0.810	-0.385		
0487.50	122	-134	237	0.441	0.810	-0.385	CB	63
0488.75	122	-133	235	0.448	0.803	-0.391		
0490.00	122	-133	233	0.444	0.803	-0.394	CB	63
0491.25	122	-133	230	0.444	0.800	-0.400		
0492.50	122	-133	228	0.450	0.793	-0.406	CC	63
0493.75	122	-133	226	0.447	0.793	-0.410		
0495.00	122	-133	224	0.447	0.790	-0.416	CC	63
0496.25	122	-133	222	0.453	0.786	-0.416		
0497.50	122	-132	219	0.450	0.783	-0.426	CC	63
0498.75	122	-132	217	0.450	0.783	-0.426		
0500.00	122	-132	215	0.456	0.776	-0.432	CD	62
0501.25	121	-132	212	0.452	0.776	-0.435		
0502.50	120	-132	209	0.452	0.773	-0.441	CD	63
0503.75	119	-132	206	0.452	0.769	-0.447		
0505.00	118	-132	202	0.455	0.766	-0.451	CD	62
0506.25	117	-132	199	0.455	0.762	-0.457		
0507.50	116	-131	196	0.455	0.762	-0.457	CE	62
0508.75	115	-131	193	0.457	0.755	-0.466		
0510.00	114	-131	190	0.457	0.755	-0.466	CE	62
0511.25	113	-131	187	0.457	0.751	-0.472		
0512.50	112	-131	183	0.453	0.751	-0.475	CE	62
0513.75	111	-131	180	0.459	0.748	-0.475		
0515.00	110	-131	177	0.459	0.744	-0.481	CF	62
0516.25	109	-131	174	0.455	0.744	-0.485		
0517.50	108	-131	171	0.461	0.736	-0.490	CF	62
0518.75	108	-130	168	0.461	0.736	-0.490		
0520.00	107	-130	165	0.457	0.732	-0.500	D0	62
0521.25	106	-130	161	0.457	0.732	-0.500		
0522.50	105	-130	158	0.463	0.729	-0.500	D0	62
0523.75	104	-130	155	0.458	0.725	-0.509		
0525.00	103	-130	152	0.458	0.725	-0.509	D0	62

T	R	Q	P	DC1	DC2	DC3	RL.CMND	P.C.CMND
0526.25	103	-130	151	0.458	0.721	-0.514		
0527.50	102	-130	150	0.460	0.717	-0.518	D1	62
0528.75	102	-130	150	0.460	0.717	-0.518		
0530.00	102	-130	149	0.460	0.713	-0.523	D1	62
0531.25	102	-130	149	0.456	0.713	-0.527		
0532.50	102	-130	148	0.461	0.710	-0.527	D1	62
0533.75	101	-130	147	0.461	0.705	-0.532		
0535.00	101	-130	146	0.457	0.705	-0.536	D1	62
0536.25	101	-130	146	0.457	0.701	-0.542		
0537.50	101	-130	145	0.462	0.698	-0.542	D2	62
0538.75	101	-130	144	0.458	0.698	-0.545		
0540.00	100	-130	143	0.458	0.693	-0.550	D2	62
0541.25	100	-130	143	0.458	0.693	-0.550		
0542.50	100	-130	142	0.459	0.690	-0.554	D2	62
0543.75	100	-130	141	0.459	0.685	-0.559		
0545.00	100	-130	141	0.459	0.685	-0.559	D3	62
0546.25	099	-130	140	0.454	0.685	-0.563		
0547.50	099	-130	139	0.460	0.677	-0.568	D3	62
0548.75	099	-130	138	0.460	0.677	-0.568		
0550.00	099	-130	138	0.460	0.673	-0.573	D3	62
0551.25	100	-129	139	0.455	0.673	-0.577		
0552.50	101	-129	141	0.460	0.669	-0.577	D4	62
0553.75	101	-128	143	0.460	0.664	-0.582		
0555.00	102	-128	145	0.456	0.664	-0.586	D4	62
0556.25	103	-127	147	0.456	0.664	-0.586		
0557.50	104	-126	149	0.461	0.656	-0.591	D4	62
0558.75	105	-126	150	0.456	0.656	-0.594		
0560.00	106	-125	152	0.456	0.656	-0.594	D4	62
0561.25	106	-125	154	0.461	0.648	-0.599		
0562.50	107	-124	156	0.456	0.648	-0.603	D5	62
0563.75	108	-123	158	0.456	0.643	-0.608		
0565.00	109	-123	160	0.456	0.643	-0.608	D5	62
0566.25	110	-122	161	0.456	0.640	-0.611		
0567.50	111	-122	163	0.456	0.635	-0.616	D6	62
0568.75	112	-121	165	0.456	0.635	-0.616		
0570.00	112	-120	167	0.451	0.630	-0.625	D6	63
0571.25	113	-120	169	0.456	0.626	-0.625		
0572.50	114	-119	170	0.456	0.626	-0.625	D6	62
0573.75	115	-118	172	0.456	0.621	-0.630		
0575.00	116	-118	174	0.456	0.618	-0.633	D7	62
0576.25	116	-117	171	0.456	0.613	-0.638		
0577.50	115	-117	168	0.456	0.613	-0.638	D7	62
0578.75	115	-116	165	0.451	0.608	-0.646		
0580.00	115	-116	161	0.456	0.604	-0.646	D8	62
0581.25	114	-115	159	0.456	0.604	-0.646		
0582.50	114	-114	155	0.456	0.599	-0.651	D8	62
0583.75	114	-114	152	0.455	0.596	-0.654		
0585.00	113	-113	149	0.455	0.590	-0.659	D9	62
0586.25	113	-113	146	0.455	0.590	-0.659		
0587.50	113	-112	143	0.450	0.590	-0.662	D9	63
0588.75	113	-111	140	0.454	0.582	-0.667		
0590.00	112	-111	137	0.454	0.582	-0.667	D9	62
0591.25	112	-110	133	0.454	0.582	-0.667		
0592.50	112	-109	130	0.453	0.573	-0.675	DA	62
0593.75	111	-109	128	0.453	0.573	-0.675		
0595.00	111	-108	124	0.453	0.573	-0.675	DA	62
0596.25	111	-108	121	0.448	0.568	-0.683		
0597.50	110	-107	118	0.453	0.564	-0.683	DA	63
0598.75	110	-106	115	0.453	0.564	-0.683		
0600.00	110	-105	112	0.453	0.559	-0.687	DB	63

T	R	Q	P	DC1	DC2	DC3	HL.CMND	PC.CMND
0601.25	109	-105	108	0.451	0.555	-0.691		
0602.50	108	-105	105	0.451	0.555	-0.691	DB	63
0603.75	106	-104	101	0.451	0.550	-0.691		
0605.00	105	-104	097	0.451	0.550	-0.698	DB	63
0606.25	104	-103	094	0.450	0.546	-0.698		
0607.50	103	-103	090	0.450	0.546	-0.698	DC	63
0608.75	102	-102	087	0.450	0.546	-0.698		
0610.00	101	-102	083	0.450	0.541	-0.703	DC	63
0611.25	100	-101	079	0.448	0.537	-0.706		
0612.50	098	-101	076	0.448	0.537	-0.706	DC	63
0613.75	097	-100	072	0.448	0.537	-0.706		
0615.00	096	-100	069	0.448	0.537	-0.706	DC	63
0616.25	095	-099	065	0.447	0.534	-0.709		
0617.50	094	-099	062	0.447	0.528	-0.714	DD	63
0618.75	093	-098	058	0.447	0.528	-0.714		
0620.00	092	-098	054	0.447	0.528	-0.714	DD	63
0621.25	090	-097	051	0.445	0.525	-0.717		
0622.50	089	-097	047	0.445	0.525	-0.717	DD	63
0623.75	088	-096	043	0.445	0.525	-0.717		
0625.00	087	-096	040	0.445	0.525	-0.717	DD	63
0626.25	087	-096	042	0.440	0.519	-0.724		
0627.50	088	-096	044	0.444	0.516	-0.724	DD	63
0628.75	088	-096	045	0.444	0.516	-0.724		
0630.00	088	-096	047	0.444	0.516	-0.724	DD	63
0631.25	089	-096	049	0.438	0.516	-0.728		
0632.50	089	-096	051	0.442	0.512	-0.728	DE	63
0633.75	089	-096	053	0.442	0.512	-0.728		
0635.00	090	-096	055	0.442	0.512	-0.728	DE	63
0636.25	090	-096	057	0.436	0.507	-0.735		
0637.50	090	-096	059	0.436	0.507	-0.735	DE	64
0638.75	091	-096	061	0.440	0.503	-0.735		
0640.00	091	-096	063	0.440	0.503	-0.735	DE	63
0641.25	091	-096	064	0.434	0.503	-0.739		
0642.50	092	-096	066	0.434	0.503	-0.739	DE	64
0643.75	092	-096	068	0.438	0.500	-0.739		
0645.00	092	-096	070	0.438	0.494	-0.743	DF	63
0646.25	093	-096	072	0.432	0.494	-0.746		
0647.50	093	-096	074	0.432	0.494	-0.746	DF	64
0648.75	094	-096	076	0.436	0.491	-0.746		
0650.00	094	-096	078	0.436	0.491	-0.746	DF	64
0651.25	095	-096	080	0.436	0.485	-0.750		
0652.50	096	-095	082	0.430	0.485	-0.753	DF	64
0653.75	097	-094	083	0.430	0.485	-0.753		
0655.00	098	-094	085	0.434	0.482	-0.753	E0	64
0656.25	099	-093	087	0.434	0.482	-0.753		
0657.50	100	-092	089	0.428	0.476	-0.760	E0	64
0658.75	101	-092	090	0.428	0.476	-0.760		
0660.00	102	-091	092	0.431	0.472	-0.760	E0	64
0661.25	103	-091	094	0.431	0.472	-0.760		
0662.50	104	-090	096	0.425	0.472	-0.763	E0	64
0663.75	105	-089	098	0.425	0.466	-0.767		
0665.00	106	-089	099	0.429	0.463	-0.767	E1	64
0666.25	107	-088	101	0.429	0.463	-0.767		
0667.50	108	-087	103	0.429	0.463	-0.767	E1	64
0668.75	109	-087	105	0.426	0.454	-0.774		
0670.00	110	-086	107	0.426	0.454	-0.774	E1	64
0671.25	111	-086	108	0.426	0.454	-0.774		
0672.50	112	-085	110	0.426	0.448	-0.777	E2	64
0673.75	113	-085	112	0.424	0.444	-0.781		
0675.00	114	-084	114	0.424	0.444	-0.781	E2	64

T	R	O	P	DC1	DC2	DC3	RL.CMND	PC.CMND
0676.25	113	-083	110	0.424	0.444	-0.781		
0677.50	112	-082	106	0.427	0.435	-0.784	E3	64
0678.75	112	-082	103	0.427	0.435	-0.784		
0680.00	111	-081	099	0.421	0.435	-0.787	E3	65
0681.25	110	-080	096	0.421	0.435	-0.787		
0682.50	110	-079	092	0.424	0.425	-0.791	E3	64
0683.75	109	-079	088	0.424	0.425	-0.791		
0685.00	108	-078	085	0.424	0.425	-0.791	E3	64
0686.25	107	-077	081	0.418	0.425	-0.794		
0687.50	107	-076	077	0.421	0.416	-0.797	E4	65
0688.75	106	-075	074	0.421	0.416	-0.797		
0690.00	106	-075	070	0.421	0.416	-0.797	E4	65
0691.25	105	-074	066	0.424	0.413	-0.797		
0692.50	104	-073	063	0.418	0.413	-0.801	E4	65
0693.75	103	-073	059	0.418	0.413	-0.801		
0695.00	103	-072	055	0.418	0.406	-0.804	E4	65
0696.25	102	-071	052	0.421	0.403	-0.804		
0697.50	101	-070	048	0.421	0.403	-0.804	98	1A
0698.75	101	-070	044	0.421	0.403	-0.804		
0700.00	100	-069	041	0.415	0.403	-0.807	98	1A
0701.25	099	-068	038	0.413	0.400	-0.807		
0702.50	098	-068	035	0.413	0.400	-0.807	98	1A
0703.75	097	-067	032	0.413	0.400	-0.807		
0705.00	096	-067	030	0.418	0.400	-0.807	98	1A
0706.25	095	-066	027	0.421	0.390	-0.810		
0707.50	093	-066	024	0.414	0.390	-0.813	97	1A
0708.75	092	-065	021	0.414	0.390	-0.813		
0710.00	091	-065	019	0.414	0.390	-0.813	97	1A
0711.25	090	-064	016	0.414	0.390	-0.813		
0712.50	089	-064	013	0.417	0.387	-0.813	97	1A
0713.75	088	-063	010	0.417	0.387	-0.813		
0715.00	087	-063	007	0.411	0.387	-0.816	97	1A
0716.25	086	-062	005	0.411	0.387	-0.816		
0717.50	085	-062	002	0.414	0.384	-0.816	97	1A
0718.75	084	-061	-001	0.414	0.384	-0.816		
0720.00	082	-061	-004	0.414	0.384	-0.816	97	1A
0721.25	081	-060	-007	0.414	0.384	-0.816		
0722.50	080	-060	-009	0.407	0.384	-0.819	97	1A
0723.75	079	-059	-012	0.410	0.381	-0.819		
0725.00	078	-059	-015	0.410	0.381	-0.819	97	1A
0726.25	078	-059	-013	0.410	0.381	-0.819		
0727.50	079	-059	-011	0.410	0.381	-0.819	97	1A
0728.75	079	-059	-008	0.410	0.381	-0.819		
0730.00	080	-059	-006	0.413	0.378	-0.819	97	1A
0731.25	080	-059	-004	0.407	0.378	-0.823		
0732.50	081	-059	-001	0.407	0.378	-0.823	97	1A
0733.75	081	-059	001	0.407	0.378	-0.823		
0735.00	082	-059	003	0.407	0.378	-0.823	97	1A
0736.25	082	-059	005	0.409	0.375	-0.823		
0737.50	083	-059	008	0.409	0.375	-0.823	96	1A
0738.75	083	-059	010	0.409	0.375	-0.823		
0740.00	083	-059	012	0.403	0.375	-0.826	96	1A
0741.25	084	-060	014	0.403	0.375	-0.826		
0742.50	084	-060	016	0.406	0.371	-0.826	96	1A
0743.75	085	-060	019	0.406	0.371	-0.826		
0745.00	085	-060	021	0.406	0.371	-0.826	96	1A
0746.25	086	-060	023	0.406	0.371	-0.826		
0747.50	086	-060	025	0.403	0.368	-0.829	96	1A
0748.75	086	-060	028	0.403	0.368	-0.829		
0750.00	087	-060	030	0.403	0.368	-0.829	96	1A

T	R	O	P	DC1	DC2	DC3	RL.CMD	PC.CMD
0751.25	088	-059	032	0.402	0.368	-0.829		
0752.50	089	-059	034	0.402	0.368	-0.829	96	19
0753.75	090	-059	036	0.405	0.365	-0.829		
0755.00	092	-058	038	0.405	0.365	-0.829	96	19
0756.25	093	-058	040	0.398	0.359	-0.835		
0757.50	094	-057	042	0.398	0.359	-0.835	95	19
0758.75	095	-057	044	0.401	0.356	-0.835		
0760.00	096	-057	046	0.401	0.356	-0.835	95	19
0761.25	097	-056	048	0.401	0.356	-0.835		
0762.50	098	-056	050	0.401	0.356	-0.835	95	19
0763.75	100	-055	052	0.404	0.353	-0.835		
0765.00	101	-055	054	0.397	0.353	-0.838	95	19
0766.25	102	-055	056	0.397	0.353	-0.838		
0767.50	103	-054	059	0.397	0.346	-0.840	95	19
0768.75	104	-054	061	0.400	0.343	-0.840		
0770.00	105	-053	063	0.400	0.343	-0.840	94	19
0771.25	106	-053	065	0.400	0.343	-0.840		
0772.50	108	-053	067	0.400	0.343	-0.840	94	19
0773.75	109	-052	069	0.402	0.340	-0.840		
0775.00	110	-052	071	0.395	0.333	-0.846	94	19
0776.25	109	-051	068	0.395	0.333	-0.846		
0777.50	109	-051	065	0.395	0.333	-0.846	94	19
0778.75	108	-050	062	0.398	0.330	-0.846		
0780.00	108	-049	059	0.398	0.330	-0.846	94	19
0781.25	107	-049	056	0.398	0.330	-0.846		
0782.50	107	-048	053	0.398	0.323	-0.849	93	19
0783.75	106	-047	050	0.394	0.320	-0.852		
0785.00	106	-047	047	0.394	0.320	-0.852	93	19
0786.25	106	-046	044	0.394	0.320	-0.852		
0787.50	105	-045	041	0.396	0.317	-0.852	93	19
0788.75	104	-045	038	0.396	0.317	-0.852		
0790.00	104	-044	035	0.396	0.317	-0.852	93	19
0791.25	103	-043	032	0.396	0.317	-0.852		
0792.50	103	-043	029	0.399	0.314	-0.852	93	19
0793.75	102	-042	026	0.399	0.314	-0.852		
0795.00	102	-042	023	0.392	0.308	-0.857	92	19
0796.25	101	-041	020	0.392	0.308	-0.857		
0797.50	101	-040	017	0.394	0.305	-0.857	92	19
0798.75	100	-040	014	0.394	0.305	-0.857		
0800.00	100	-039	011	0.394	0.305	-0.857	92	19
0801.25	099	-038	008	0.394	0.305	-0.857		
0802.50	098	-038	006	0.396	0.302	-0.857	92	19
0803.75	098	-038	003	0.396	0.302	-0.857		
0805.00	097	-037	000	0.396	0.302	-0.857	92	19
0806.25	096	-037	-003	0.396	0.302	-0.857		
0807.50	095	-036	-006	0.399	0.298	-0.857	92	19
0808.75	095	-036	-008	0.392	0.298	-0.860		
0810.00	094	-036	-011	0.392	0.298	-0.860	92	19
0811.25	093	-035	-014	0.392	0.298	-0.860		
0812.50	092	-035	-017	0.394	0.295	-0.860	91	19
0813.75	092	-034	-019	0.394	0.295	-0.860		
0815.00	091	-034	-022	0.394	0.295	-0.860	91	19
0816.25	090	-034	-025	0.394	0.295	-0.860		
0817.50	089	-033	-028	0.394	0.295	-0.860	91	19
0818.75	089	-032	-030	0.396	0.292	-0.860		
0820.00	088	-032	-033	0.396	0.292	-0.860	91	19
0821.25	087	-032	-036	0.396	0.292	-0.860		
0822.50	086	-032	-039	0.390	0.292	-0.863	91	19
0823.75	085	-031	-041	0.392	0.289	-0.863		
0825.00	085	-031	-044	0.392	0.289	-0.863	91	19

T	R	Q	P	DC1	DC2	DC3	RL.COMD	PC.COMD
0826.25	086	-031	-042	0.392	0.289	-0.363		
0827.50	087	-031	-040	0.392	0.289	-0.363	91	19
0828.75	088	-031	-037	0.392	0.289	-0.363		
0830.00	089	-031	-035	0.394	0.286	-0.363	91	19
0831.25	090	-031	-033	0.394	0.293	-0.361		
0832.50	090	-031	-031	0.394	0.293	-0.361	91	19
0833.75	091	-031	-028	0.394	0.293	-0.361		
0835.00	092	-031	-026	0.396	0.290	-0.361	91	19
0836.25	093	-031	-024	0.396	0.290	-0.361		
0837.50	094	-031	-021	0.396	0.290	-0.361	91	19
0838.75	095	-031	-019	0.389	0.290	-0.364		
0840.00	096	-031	-017	0.389	0.290	-0.364	91	19
0841.25	097	-031	-015	0.391	0.287	-0.364		
0842.50	098	-031	-012	0.391	0.287	-0.364	91	19
0843.75	099	-031	-010	0.391	0.287	-0.364		
0845.00	100	-031	-008	0.391	0.287	-0.364	91	19
0846.25	101	-031	-006	0.394	0.284	-0.364		
0847.50	102	-031	-003	0.394	0.284	-0.364	91	19
0848.75	103	-031	-001	0.394	0.284	-0.364		
0850.00	104	-031	001	0.394	0.284	-0.364	91	19
0851.25	105	-031	003	0.396	0.281	-0.364		
0852.50	106	-031	005	0.396	0.281	-0.364	90	19
0853.75	106	-030	007	0.396	0.281	-0.864		
0855.00	107	-030	009	0.391	0.278	-0.367	90	19
0856.25	108	-030	011	0.391	0.278	-0.367		
0857.50	109	-030	013	0.391	0.278	-0.367	90	19
0858.75	110	-030	015	0.391	0.278	-0.367		
0860.00	111	-030	017	0.393	0.275	-0.367	90	19
0861.25	112	-030	019	0.393	0.275	-0.367		
0862.50	112	-029	021	0.393	0.275	-0.367	90	19
0863.75	113	-029	023	0.393	0.275	-0.367		
0865.00	114	-029	025	0.395	0.272	-0.367	90	19
0866.25	115	-029	028	0.395	0.272	-0.367		
0867.50	116	-029	030	0.395	0.272	-0.367	90	19
0868.75	117	-029	032	0.397	0.269	-0.367		
0870.00	117	-028	034	0.397	0.269	-0.367	90	19
0871.25	118	-028	036	0.397	0.269	-0.367		
0872.50	119	-028	038	0.392	0.266	-0.370	90	19
0873.75	120	-028	040	0.392	0.266	-0.870		
0875.00	121	-028	042	0.392	0.266	-0.870	90	19
0876.25	120	-028	039	0.392	0.266	-0.870		
0877.50	120	-027	037	0.394	0.263	-0.870	8F	19
0878.75	119	-027	035	0.394	0.263	-0.870		
0880.00	119	-027	032	0.394	0.263	-0.870	8F	19
0881.25	118	-027	030	0.396	0.260	-0.870		
0882.50	118	-026	028	0.396	0.260	-0.870	8F	19
0883.75	117	-026	025	0.396	0.260	-0.870		
0885.00	117	-026	023	0.396	0.253	-0.872	8F	19
0886.25	116	-026	020	0.398	0.250	-0.872		
0887.50	116	-025	018	0.398	0.250	-0.872	8E	19
0888.75	115	-025	016	0.398	0.250	-0.872		
0890.00	114	-025	013	0.400	0.247	-0.872	8E	19
0891.25	114	-025	011	0.393	0.247	-0.875		
0892.50	113	-024	009	0.393	0.247	-0.875	8E	19
0893.75	113	-024	006	0.395	0.244	-0.875		
0895.00	112	-024	004	0.395	0.244	-0.875	8E	19
0896.25	112	-024	001	0.395	0.244	-0.875		
0897.50	111	-023	-001	0.395	0.244	-0.875	8E	19
0898.75	110	-023	-003	0.397	0.241	-0.875		
0900.00	110	-023	-006	0.397	0.241	-0.875	8E	19

T	R	Q	P	DC1	DC2	DC3	RL.COMD	PC.COMD

T	R	Q	P	DC1	DC2	DC3		
0901.25	109	-023	-008	0.397	0.241	-0.875		
0902.50	109	-023	-010	0.397	0.241	-0.875	8E	19
0903.75	108	-023	-012	0.399	0.238	-0.875		
0905.00	107	-023	-014	0.399	0.238	-0.875	8E	19
0906.25	107	-023	-016	0.399	0.238	-0.875		
0907.50	106	-023	-018	0.400	0.235	-0.875	8E	19
0908.75	105	-023	-020	0.400	0.235	-0.875		
0910.00	105	-023	-022	0.400	0.235	-0.875	8E	19
0911.25	104	-023	-024	0.400	0.235	-0.875		
0912.50	104	-023	-026	0.395	0.232	-0.878	8D	19
0913.75	103	-023	-028	0.395	0.232	-0.878		
0915.00	102	-023	-030	0.395	0.232	-0.878	8D	19
0916.25	102	-023	-032	0.395	0.232	-0.878		
0917.50	101	-023	-034	0.397	0.229	-0.878	8D	19
0918.75	100	-023	-036	0.397	0.229	-0.878		
0920.00	100	-023	-038	0.397	0.229	-0.878	8D	19
0921.25	099	-023	-040	0.397	0.229	-0.878		
0922.50	098	-023	-042	0.399	0.225	-0.878	8D	19
0923.75	098	-023	-044	0.399	0.225	-0.878		
0925.00	097	-023	-046	0.399	0.225	-0.878	8D	19
0926.25	098	-023	-044	0.399	0.232	-0.877		
0927.50	098	-023	-042	0.400	0.229	-0.877	8D	19
0928.75	099	-023	-040	0.400	0.229	-0.877		
0930.00	100	-023	-038	0.400	0.229	-0.877	8D	19
0931.25	100	-023	-036	0.400	0.229	-0.877		
0932.50	101	-023	-034	0.402	0.226	-0.877	8D	19
0933.75	102	-023	-032	0.395	0.226	-0.880		
0935.00	103	-023	-030	0.395	0.226	-0.880	8D	19
0936.25	103	-023	-027	0.395	0.226	-0.880		
0937.50	104	-023	-025	0.397	0.223	-0.880	8D	19
0938.75	105	-023	-023	0.397	0.223	-0.880		
0940.00	105	-023	-021	0.397	0.223	-0.880	8D	19
0941.25	106	-023	-019	0.397	0.230	-0.878		
0942.50	107	-023	-017	0.398	0.227	-0.878	8D	19
0943.75	107	-023	-015	0.398	0.227	-0.878		
0945.00	108	-023	-013	0.398	0.227	-0.878	8D	19
0946.25	109	-023	-011	0.398	0.227	-0.878		
0947.50	109	-023	-009	0.400	0.224	-0.878	8D	19
0948.75	110	-023	-007	0.400	0.224	-0.878		
0950.00	111	-023	-005	0.400	0.224	-0.878	8D	19
0951.25	112	-023	-003	0.402	0.221	-0.878		
0952.50	112	-023	-002	0.402	0.221	-0.878	8D	19
0953.75	113	-023	-000	0.402	0.221	-0.878		
0955.00	114	-023	001	0.395	0.221	-0.881	8D	19
0956.25	114	-023	003	0.396	0.218	-0.881		
0957.50	115	-023	005	0.396	0.218	-0.881	8C	19
0958.75	116	-023	006	0.396	0.218	-0.881		
0960.00	117	-023	008	0.398	0.215	-0.881	8C	19
0961.25	117	-023	010	0.398	0.215	-0.881		
0962.50	118	-023	011	0.398	0.215	-0.881	8C	19
0963.75	118	-023	013	0.398	0.215	-0.881		
0965.00	119	-023	014	0.400	0.212	-0.881	8C	19
0966.25	120	-023	016	0.400	0.212	-0.881		
0967.50	121	-023	017	0.400	0.212	-0.881	8C	19
0968.75	121	-023	019	0.401	0.209	-0.881		
0970.00	122	-023	021	0.401	0.209	-0.881	8C	19
0971.25	123	-023	022	0.401	0.209	-0.881		
0972.50	123	-023	024	0.403	0.206	-0.881	8C	19
0973.75	124	-023	025	0.403	0.206	-0.881		
0975.00	125	-023	027	0.403	0.206	-0.881	8C	19

T	R	Q	P	DC1	DC2	DC3	RL.CMD	PC.CMD
0976.25	125	-023	026	0.404	0.203	-0.884		
0977.50	125	-022	025	0.397	0.203	-0.884	8B	19
0978.75	124	-022	024	0.397	0.203	-0.884		
0980.00	124	-022	022	0.397	0.203	-0.884	8B	19
0981.25	124	-022	021	0.399	0.200	-0.884		
0982.50	124	-022	020	0.399	0.200	-0.884	8B	19
0983.75	124	-021	019	0.399	0.200	-0.884		
0985.00	124	-021	018	0.400	0.197	-0.884	8B	19
0986.25	124	-021	017	0.400	0.197	-0.884		
0987.50	123	-021	016	0.400	0.197	-0.884	8B	19
0988.75	123	-021	015	0.402	0.194	-0.884		
0990.00	123	-021	014	0.402	0.194	-0.884	8B	19
0991.25	123	-020	013	0.402	0.194	-0.884		
0992.50	123	-020	011	0.403	0.191	-0.884	8B	19
0993.75	123	-020	011	0.403	0.191	-0.884		
0995.00	122	-020	009	0.403	0.191	-0.884	8B	19
0996.25	122	-020	008	0.403	0.184	-0.885		
0997.50	122	-019	007	0.405	0.181	-0.885	8A	19
0998.75	122	-019	006	0.405	0.181	-0.885		
1000.00	122	-019	005	0.405	0.181	-0.885	8A	19
1001.25	121	-019	004	0.399	0.177	-0.889		
1002.50	120	-019	002	0.399	0.177	-0.889	8A	19
1003.75	120	-019	001	0.399	0.177	-0.889		
1005.00	119	-019	-000	0.400	0.174	-0.889	8A	19
1006.25	118	-019	-002	0.400	0.174	-0.889		
1007.50	118	-019	-003	0.400	0.174	-0.889	8A	19
1008.75	117	-019	-005	0.401	0.171	-0.889		
1010.00	116	-018	-006	0.401	0.171	-0.889	89	19
1011.25	116	-018	-007	0.401	0.171	-0.889		
1012.50	115	-018	-009	0.401	0.171	-0.889	89	19
1013.75	114	-018	-010	0.403	0.168	-0.889		
1015.00	114	-018	-011	0.403	0.168	-0.889	89	19
1016.25	113	-018	-013	0.403	0.168	-0.889		
1017.50	112	-018	-014	0.404	0.165	-0.889	89	19
1018.75	111	-018	-015	0.404	0.165	-0.889		
1020.00	111	-018	-017	0.404	0.165	-0.889	89	19
1021.25	110	-018	-018	0.404	0.165	-0.889		
1022.50	109	-018	-019	0.405	0.162	-0.889	89	19
1023.75	109	-018	-021	0.405	0.162	-0.889		
1025.00	108	-018	-022	0.405	0.162	-0.889	89	19
1026.25	108	-018	-022	0.405	0.162	-0.889		
1027.50	108	-018	-021	0.406	0.159	-0.889	89	1A
1028.75	107	-018	-021	0.399	0.159	-0.892		
1030.00	107	-018	-021	0.399	0.159	-0.892	89	19
1031.25	107	-018	-021	0.400	0.156	-0.892		
1032.50	107	-018	-021	0.400	0.156	-0.892	98	19
1033.75	107	-018	-021	0.400	0.156	-0.892		
1035.00	107	-018	-020	0.400	0.156	-0.892	98	19
1036.25	106	-018	-020	0.401	0.153	-0.892		
1037.50	106	-018	-020	0.401	0.153	-0.892	98	19
1038.75	106	-018	-020	0.401	0.153	-0.892		
1040.00	106	-018	-020	0.401	0.153	-0.892	98	19
1041.25	106	-018	-019	0.403	0.157	-0.891		
1042.50	106	-018	-019	0.403	0.157	-0.891	89	19
1043.75	106	-018	-019	0.403	0.157	-0.891		
1045.00	106	-018	-019	0.403	0.157	-0.891	99	19
1046.25	105	-018	-019	0.404	0.154	-0.891		
1047.50	105	-018	-018	0.404	0.154	-0.891	98	19
1048.75	105	-018	-018	0.404	0.154	-0.891		
1050.00	105	-018	-018	0.405	0.151	-0.891	88	19

T	R	Q	P	DC1	DC2	DC3	AL.CMND	PL.CMD
1051.25	105	-018	-017	0.405	0.151	-0.891		
1052.50	106	-018	-016	0.405	0.151	-0.891	88	19
1053.75	106	-018	-016	0.405	0.151	-0.891		
1055.00	106	-018	-015	0.406	0.148	-0.891	88	19
1056.25	106	-018	-014	0.399	0.148	-0.894		
1057.50	107	-018	-014	0.399	0.148	-0.894	88	19
1058.75	107	-018	-013	0.399	0.148	-0.894		
1060.00	107	-018	-012	0.400	0.145	-0.894	88	19
1061.25	107	-018	-011	0.400	0.145	-0.894		
1062.50	108	-018	-011	0.400	0.145	-0.894	88	19
1063.75	108	-018	-010	0.400	0.145	-0.894		
1065.00	108	-018	-010	0.401	0.142	-0.894	88	19
1066.25	109	-018	-009	0.401	0.142	-0.894		
1067.50	109	-018	-008	0.401	0.142	-0.894	88	19
1068.75	109	-018	-007	0.402	0.139	-0.894		
1070.00	110	-018	-007	0.402	0.139	-0.894	87	19
1071.25	110	-018	-006	0.402	0.139	-0.894		
1072.50	110	-018	-005	0.402	0.139	-0.894	87	19
1073.75	111	-018	-005	0.403	0.136	-0.894		
1075.00	111	-018	-004	0.403	0.136	-0.894	87	19
1076.25	111	-018	-004	0.403	0.136	-0.894		
1077.50	111	-018	-004	0.403	0.136	-0.894	87	19
1078.75	111	-018	-004	0.404	0.133	-0.894		
1080.00	110	-017	-003	0.404	0.133	-0.894	87	19
1081.25	110	-017	-003	0.404	0.133	-0.894		
1082.50	110	-017	-003	0.405	0.130	-0.894	87	19
1083.75	110	-017	-003	0.398	0.130	-0.897		
1085.00	110	-017	-003	0.398	0.130	-0.897	87	19
1086.25	110	-017	-003	0.398	0.130	-0.897		
1087.50	110	-017	-003	0.399	0.126	-0.897	87	19
1088.75	110	-017	-003	0.399	0.126	-0.897		
1090.00	110	-017	-003	0.399	0.126	-0.897	87	19
1091.25	110	-017	-003	0.400	0.130	-0.896		
1092.50	109	-016	-002	0.400	0.130	-0.896	87	19
1093.75	109	-016	-002	0.400	0.130	-0.896		
1095.00	109	-016	-002	0.400	0.130	-0.896	87	19
1096.25	109	-015	-002	0.401	0.127	-0.896		
1097.50	109	-016	-002	0.401	0.127	-0.896	87	19
1098.75	109	-016	-002	0.401	0.127	-0.896		
1100.00	109	-016	-002	0.401	0.127	-0.896	87	19
1101.25	109	-016	-002	0.401	0.124	-0.896		
1102.50	109	-016	-002	0.401	0.124	-0.896	86	19
1103.75	108	-016	-002	0.401	0.124	-0.896		
1105.00	108	-016	-003	0.402	0.121	-0.896	86	19
1106.25	108	-016	-003	0.402	0.121	-0.896		
1107.50	108	-016	-003	0.402	0.121	-0.896	86	19
1108.75	108	-016	-003	0.402	0.121	-0.896		
1110.00	108	-015	-003	0.403	0.118	-0.896	86	19
1111.25	107	-015	-004	0.403	0.118	-0.896		
1112.50	107	-015	-004	0.403	0.118	-0.896	86	19
1113.75	107	-015	-004	0.403	0.118	-0.896		
1115.00	107	-015	-004	0.397	0.115	-0.899	86	19
1116.25	107	-015	-004	0.397	0.115	-0.899		
1117.50	107	-015	-005	0.397	0.115	-0.899	86	19
1118.75	106	-015	-005	0.398	0.112	-0.899		
1120.00	106	-015	-005	0.398	0.112	-0.899	86	19
1121.25	106	-015	-005	0.398	0.112	-0.899		
1122.50	106	-015	-005	0.398	0.112	-0.899	86	19
1123.75	106	-015	-006	0.399	0.109	-0.899		
1125.00	106	-015	-006	0.399	0.109	-0.899	85	19

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1126.25	106	-015	-006	0.399	0.109	-0.899		
1127.50	106	-015	-006	0.399	0.109	-0.899	85	19
1128.75	105	-015	-006	0.399	0.106	-0.899		
1130.00	105	-015	-007	0.399	0.106	-0.899	85	19
1131.25	105	-015	-007	0.399	0.106	-0.899		
1132.50	105	-015	-007	0.399	0.106	-0.899	85	19
1133.75	105	-016	-007	0.400	0.103	-0.899		
1135.00	105	-016	-007	0.400	0.103	-0.899	85	19
1136.25	105	-016	-008	0.400	0.103	-0.899		
1137.50	104	-016	-008	0.400	0.103	-0.899	85	19
1138.75	104	-016	-008	0.401	0.100	-0.899		
1140.00	104	-016	-008	0.401	0.100	-0.899	85	19
1141.25	104	-016	-008	0.401	0.100	-0.899		
1142.50	104	-016	-009	0.401	0.097	-0.899	85	19
1143.75	104	-016	-009	0.401	0.097	-0.899		
1145.00	103	-016	-009	0.401	0.097	-0.399	85	19
1146.25	103	-017	-009	0.401	0.097	-0.899		
1147.50	103	-017	-009	0.395	0.094	-0.902	85	19
1148.75	103	-017	-010	0.395	0.094	-0.902		
1150.00	103	-017	-010	0.395	0.094	-0.902	85	19
1151.25	103	-017	-010	0.395	0.094	-0.902		
1152.50	103	-017	-010	0.396	0.091	-0.902	84	19
1153.75	103	-017	-010	0.396	0.091	-0.902		
1155.00	103	-018	-010	0.396	0.091	-0.902	84	19
1156.25	103	-018	-011	0.396	0.091	-0.902		
1157.50	103	-018	-011	0.396	0.088	-0.902	84	19
1158.75	103	-018	-011	0.396	0.088	-0.902		
1160.00	103	-018	-011	0.396	0.088	-0.902	84	19
1161.25	103	-019	-011	0.396	0.088	-0.902		
1162.50	103	-019	-011	0.397	0.085	-0.902	84	19
1163.75	103	-019	-011	0.397	0.085	-0.902		
1165.00	103	-019	-011	0.397	0.085	-0.902	84	19
1166.25	104	-019	-011	0.397	0.085	-0.902		
1167.50	104	-020	-011	0.398	0.082	-0.902	84	19
1168.75	104	-020	-012	0.398	0.089	-0.901		
1170.00	104	-020	-012	0.398	0.089	-0.901	84	19
1171.25	104	-020	-012	0.398	0.089	-0.901		
1172.50	104	-020	-012	0.398	0.086	-0.901	84	19
1173.75	104	-021	-012	0.398	0.086	-0.901		
1175.00	104	-021	-012	0.391	0.086	-0.904	84	19
1176.25	104	-021	-012	0.392	0.083	-0.904		
1177.50	104	-021	-012	0.392	0.083	-0.904	84	19
1178.75	104	-021	-012	0.392	0.083	-0.904		
1180.00	104	-021	-012	0.392	0.083	-0.904	84	19
1181.25	104	-022	-013	0.392	0.080	-0.904		
1182.50	104	-022	-013	0.392	0.080	-0.904	84	19
1183.75	104	-022	-013	0.392	0.080	-0.904		
1185.00	104	-022	-013	0.392	0.080	-0.904	84	19
1186.25	104	-023	-013	0.393	0.077	-0.904		
1187.50	104	-023	-013	0.393	0.077	-0.904	83	19
1188.75	104	-023	-013	0.393	0.077	-0.904		
1190.00	104	-023	-013	0.393	0.077	-0.904	83	19
1191.25	104	-023	-013	0.393	0.073	-0.904		
1192.50	104	-024	-013	0.393	0.073	-0.904	83	19
1193.75	104	-024	-013	0.393	0.073	-0.904		
1195.00	104	-024	-014	0.393	0.073	-0.904	83	19
1196.25	104	-024	-014	0.387	0.070	-0.907		
1197.50	104	-024	-014	0.387	0.070	-0.907	83	18
1198.75	104	-025	-014	0.387	0.070	-0.907		
1200.00	104	-025	-014	0.387	0.070	-0.907	83	18

T	R	Q	P	DC1	DC2	DC3	EL.COMD	PC.COMD
1201.25	104	-025	-014	0.387	0.068	-0.907		
1202.50	104	-025	-014	0.387	0.068	-0.907	83	18
1203.75	104	-025	-014	0.387	0.068	-0.907		
1205.00	104	-026	-014	0.388	0.065	-0.907	83	18
1206.25	104	-026	-014	0.388	0.072	-0.907		
1207.50	104	-026	-014	0.388	0.072	-0.907	83	18
1208.75	104	-026	-015	0.388	0.072	-0.907		
1210.00	103	-026	-015	0.388	0.069	-0.907	83	18
1211.25	103	-027	-015	0.388	0.069	-0.907		
1212.50	103	-027	-015	0.388	0.069	-0.907	83	18
1213.75	103	-027	-015	0.388	0.069	-0.907		
1215.00	103	-027	-015	0.389	0.066	-0.907	83	18
1216.25	103	-027	-015	0.381	0.066	-0.910		
1217.50	103	-028	-015	0.381	0.066	-0.910	83	18
1218.75	103	-028	-015	0.381	0.066	-0.910		
1220.00	103	-028	-015	0.382	0.063	-0.910	83	18
1221.25	103	-028	-016	0.382	0.063	-0.910		
1222.50	103	-028	-016	0.382	0.063	-0.910	83	18
1223.75	103	-029	-016	0.382	0.063	-0.910		
1225.00	103	-029	-016	0.382	0.060	-0.910	82	18
1226.25	103	-029	-016	0.382	0.060	-0.910		
1227.50	103	-029	-016	0.382	0.060	-0.910	82	18
1228.75	103	-030	-016	0.382	0.060	-0.910		
1230.00	102	-030	-016	0.383	0.057	-0.910	82	18
1231.25	102	-030	-016	0.383	0.057	-0.910		
1232.50	102	-030	-016	0.383	0.057	-0.910	82	18
1233.75	102	-031	-017	0.375	0.057	-0.913		
1235.00	102	-031	-017	0.376	0.054	-0.913	82	18
1236.25	102	-031	-017	0.376	0.054	-0.913		
1237.50	102	-032	-017	0.376	0.054	-0.913	82	18
1238.75	102	-032	-017	0.376	0.061	-0.912		
1240.00	102	-032	-017	0.376	0.058	-0.912	82	13
1241.25	102	-032	-017	0.376	0.058	-0.912		
1242.50	101	-032	-017	0.376	0.058	-0.912	82	18
1243.75	101	-033	-017	0.376	0.058	-0.912		
1245.00	101	-033	-017	0.376	0.056	-0.912	82	18
1246.25	101	-033	-018	0.376	0.056	-0.912		
1247.50	101	-033	-018	0.376	0.056	-0.912	82	18
1248.75	101	-034	-018	0.370	0.053	-0.915		
1250.00	101	-034	-018	0.370	0.053	-0.915	82	17
1251.25	101	-034	-018	0.370	0.053	-0.915		
1252.50	101	-034	-018	0.370	0.053	-0.915	82	17
1253.75	101	-035	-019	0.370	0.050	-0.915		
1255.00	101	-035	-019	0.370	0.050	-0.915	82	17
1256.25	102	-035	-019	0.370	0.050	-0.915		
1257.50	102	-035	-019	0.370	0.050	-0.915	82	17
1258.75	102	-036	-019	0.370	0.047	-0.915		
1260.00	102	-036	-020	0.370	0.047	-0.915	82	17
1261.25	102	-036	-020	0.370	0.047	-0.915		
1262.50	102	-036	-020	0.370	0.047	-0.915	82	17
1263.75	103	-037	-020	0.363	0.044	-0.918		
1265.00	103	-037	-020	0.363	0.044	-0.918	81	17
1266.25	103	-037	-021	0.363	0.051	-0.918		
1267.50	103	-037	-021	0.363	0.051	-0.918	82	17
1268.75	103	-038	-021	0.364	0.049	-0.918		
1270.00	103	-038	-021	0.364	0.049	-0.918	82	17
1271.25	103	-038	-021	0.364	0.049	-0.918		
1272.50	104	-038	-021	0.364	0.049	-0.918	82	17
1273.75	104	-039	-022	0.364	0.046	-0.918		
1275.00	104	-039	-022	0.364	0.046	-0.918	81	17

T	R	Q	P	DC1	DC2	DC3	EL.CMND	PC.CMND
1276.25	104	-039	-022	0.357	0.046	-0.921		
1277.50	104	-040	-022	0.357	0.046	-0.921	81	16
1278.75	104	-040	-023	0.357	0.043	-0.921		
1280.00	104	-040	-023	0.357	0.043	-0.921	81	16
1281.25	104	-040	-023	0.357	0.043	-0.921		
1282.50	104	-041	-023	0.357	0.043	-0.921	81	16
1283.75	105	-041	-024	0.357	0.040	-0.921		
1285.00	105	-041	-024	0.357	0.040	-0.921	81	16
1286.25	105	-042	-024	0.357	0.040	-0.921		
1287.50	105	-042	-024	0.358	0.038	-0.921	81	16
1288.75	105	-042	-025	0.350	0.045	-0.923		
1290.00	105	-043	-025	0.350	0.045	-0.923	81	16
1291.25	105	-043	-025	0.350	0.045	-0.923		
1292.50	105	-043	-025	0.350	0.042	-0.923	81	16
1293.75	105	-043	-026	0.350	0.042	-0.923		
1295.00	105	-044	-026	0.350	0.042	-0.923	81	16
1296.25	106	-044	-026	0.350	0.042	-0.923		
1297.50	106	-044	-026	0.351	0.040	-0.923	81	16
1298.75	106	-045	-027	0.351	0.040	-0.923		
1300.00	106	-045	-027	0.343	0.040	-0.926	81	15
1301.25	106	-045	-027	0.343	0.040	-0.926		
1302.50	106	-046	-027	0.344	0.037	-0.926	81	15
1303.75	106	-046	-028	0.344	0.037	-0.926		
1305.00	106	-046	-028	0.344	0.037	-0.926	81	15
1306.25	106	-047	-028	0.344	0.037	-0.926		
1307.50	107	-047	-028	0.344	0.042	-0.926	81	16
1308.75	107	-048	-029	0.344	0.042	-0.926		
1310.00	107	-048	-029	0.344	0.042	-0.926	81	16
1311.25	107	-048	-029	0.337	0.039	-0.928		
1312.50	107	-049	-030	0.337	0.039	-0.928	81	15
1313.75	107	-049	-030	0.337	0.039	-0.928		
1315.00	108	-050	-030	0.337	0.039	-0.928	81	15
1316.25	108	-050	-030	0.337	0.037	-0.928		
1317.50	108	-050	-031	0.337	0.037	-0.928	81	15
1318.75	108	-051	-031	0.337	0.037	-0.928		
1320.00	108	-051	-031	0.337	0.037	-0.928	81	15
1321.25	108	-052	-031	0.330	0.034	-0.931		
1322.50	109	-052	-032	0.330	0.034	-0.931	81	15
1323.75	109	-052	-032	0.330	0.041	-0.931		
1325.00	109	-053	-032	0.330	0.039	-0.931	81	15
1326.25	109	-053	-032	0.330	0.039	-0.931		
1327.50	109	-053	-032	0.330	0.039	-0.931	81	15
1328.75	109	-053	-033	0.330	0.039	-0.931		
1330.00	109	-054	-033	0.330	0.036	-0.931	81	15
1331.25	110	-054	-033	0.323	0.036	-0.933		
1332.50	110	-054	-033	0.323	0.036	-0.933	81	14
1333.75	110	-054	-034	0.323	0.036	-0.933		
1335.00	110	-055	-034	0.323	0.034	-0.933	81	14
1336.25	110	-055	-034	0.323	0.034	-0.933		
1337.50	110	-055	-035	0.323	0.034	-0.933	81	14
1338.75	111	-055	-035	0.324	0.039	-0.933		
1340.00	111	-056	-035	0.316	0.039	-0.935	81	14
1341.25	111	-056	-035	0.316	0.039	-0.935		
1342.50	111	-056	-036	0.316	0.039	-0.935	81	14
1343.75	111	-057	-036	0.317	0.036	-0.935		
1345.00	111	-057	-036	0.317	0.036	-0.935	81	14
1346.25	111	-057	-036	0.317	0.036	-0.935		
1347.50	112	-057	-037	0.317	0.034	-0.935	81	14
1348.75	112	-058	-037	0.309	0.034	-0.938		
1350.00	112	-058	-037	0.309	0.034	-0.938	81	13

T	R	Q	P	DC1	DC2	DC3	RL. CMD	PC. CMD
1351.25	112	-058	-037	0.309	0.034	-0.938		
1352.50	112	-058	-038	0.310	0.039	-0.938	81	13
1353.75	112	-059	-038	0.310	0.039	-0.938		
1355.00	112	-059	-038	0.310	0.039	-0.938	81	13
1356.25	113	-059	-038	0.310	0.039	-0.938		
1357.50	113	-059	-039	0.302	0.037	-0.940	81	13
1358.75	113	-060	-039	0.302	0.037	-0.940		
1360.00	113	-060	-039	0.302	0.037	-0.940	81	13
1361.25	113	-060	-039	0.303	0.034	-0.940		
1362.50	113	-060	-040	0.303	0.034	-0.940	81	13
1363.75	114	-061	-040	0.303	0.034	-0.940		
1365.00	114	-061	-040	0.295	0.034	-0.942	81	12
1366.25	114	-061	-040	0.295	0.040	-0.942		
1367.50	114	-061	-040	0.295	0.040	-0.942	81	12
1368.75	114	-062	-041	0.295	0.040	-0.942		
1370.00	114	-062	-041	0.296	0.037	-0.942	81	12
1371.25	114	-062	-041	0.296	0.037	-0.942		
1372.50	115	-062	-041	0.296	0.037	-0.942	81	12
1373.75	115	-063	-042	0.288	0.037	-0.944		
1375.00	115	-063	-042	0.288	0.035	-0.944	81	12
1376.25	115	-063	-042	0.288	0.035	-0.944		
1377.50	115	-063	-043	0.288	0.043	-0.944	81	12
1378.75	115	-064	-043	0.289	0.040	-0.944		
1380.00	116	-064	-043	0.289	0.040	-0.944	81	12
1381.25	116	-064	-044	0.281	0.040	-0.946		
1382.50	116	-064	-044	0.281	0.040	-0.946	81	12
1383.75	116	-064	-044	0.281	0.038	-0.946		
1385.00	116	-065	-045	0.281	0.038	-0.946	81	12
1386.25	116	-065	-045	0.281	0.038	-0.946		
1387.50	117	-065	-046	0.282	0.036	-0.946	81	12
1388.75	117	-065	-046	0.274	0.043	-0.948		
1390.00	117	-066	-046	0.274	0.043	-0.948	81	11
1391.25	117	-066	-047	0.275	0.041	-0.948		
1392.50	117	-066	-047	0.275	0.041	-0.948	81	11
1393.75	117	-067	-047	0.275	0.041	-0.948		
1395.00	117	-067	-048	0.275	0.041	-0.948	81	11
1396.25	117	-067	-048	0.267	0.039	-0.950		
1397.50	118	-067	-049	0.267	0.039	-0.950	81	11
1398.75	118	-068	-049	0.267	0.039	-0.950		
1400.00	118	-068	-049	0.268	0.045	-0.950	81	11
1401.25	118	-068	-050	0.268	0.045	-0.950		
1402.50	118	-068	-050	0.268	0.045	-0.950	81	11
1403.75	118	-068	-050	0.260	0.045	-0.952		
1405.00	118	-068	-050	0.260	0.043	-0.952	81	10
1406.25	118	-068	-051	0.260	0.043	-0.952		
1407.50	118	-068	-051	0.260	0.043	-0.952	81	10
1408.75	119	-069	-051	0.261	0.041	-0.952		
1410.00	119	-069	-051	0.261	0.048	-0.952	82	10
1411.25	119	-069	-052	0.253	0.048	-0.954		
1412.50	119	-069	-052	0.253	0.046	-0.954	81	10
1413.75	119	-069	-052	0.253	0.046	-0.954		
1415.00	119	-069	-052	0.253	0.046	-0.954	81	10
1416.25	119	-069	-052	0.253	0.046	-0.954		
1417.50	119	-069	-053	0.254	0.044	-0.954	81	10
1418.75	119	-069	-053	0.246	0.052	-0.956		
1420.00	119	-069	-053	0.246	0.052	-0.956	82	09
1421.25	120	-070	-053	0.246	0.050	-0.956		
1422.50	120	-070	-053	0.246	0.050	-0.956	82	09
1423.75	120	-070	-054	0.246	0.050	-0.956		
1425.00	120	-070	-054	0.247	0.048	-0.956	82	09

T	R	Q	P	DC1	DC2	DC3	RL.CMND	PC.CMND
1426.25	120	-070	-054	0.239	0.048	-0.957		
1427.50	120	-070	-054	0.239	0.048	-0.957	82	OF
1428.75	120	-070	-055	0.239	0.056	-0.957		
430.00	120	-070	-055	0.240	0.054	-0.957	82	OF
1421.25	121	-071	-055	0.240	0.054	-0.957		
1432.50	121	-071	-055	0.232	0.054	-0.959	82	OE
1433.75	121	-071	-056	0.232	0.052	-0.959		
1435.00	121	-071	-056	0.232	0.052	-0.959	82	OE
1436.25	121	-071	-056	0.232	0.052	-0.959		
1437.50	121	-071	-056	0.233	0.058	-0.958	82	OE
1438.75	122	-072	-057	0.233	0.058	-0.958		
1440.00	122	-072	-057	0.225	0.058	-0.960	82	OE
1441.25	122	-072	-057	0.225	0.058	-0.960		
1442.50	122	-072	-057	0.225	0.056	-0.960	82	OE
1443.75	122	-072	-058	0.225	0.056	-0.960		
1445.00	122	-072	-058	0.225	0.056	-0.960	82	OE
1446.25	122	-072	-058	0.218	0.062	-0.961		
1447.50	123	-073	-058	0.218	0.062	-0.961	82	OD
1448.75	123	-073	-059	0.218	0.062	-0.961		
1450.00	123	-073	-059	0.219	0.061	-0.961	82	OD
1451.25	123	-073	-059	0.219	0.061	-0.961		
1452.50	123	-073	-059	0.219	0.061	-0.961	82	OD
1453.75	123	-073	-060	0.211	0.059	-0.963		
1455.00	123	-073	-060	0.211	0.067	-0.963	83	OD
1456.25	124	-073	-060	0.211	0.067	-0.963		
1457.50	124	-074	-060	0.211	0.067	-0.963	83	OD
1458.75	124	-074	-061	0.212	0.065	-0.963		
1460.00	124	-074	-061	0.204	0.065	-0.964	83	OD
1461.25	124	-074	-061	0.204	0.065	-0.964		
1462.50	124	-074	-062	0.205	0.063	-0.964	83	OD
1463.75	125	-074	-062	0.205	0.071	-0.964		
1465.00	125	-074	-062	0.205	0.071	-0.964	83	OD
1466.25	125	-074	-062	0.205	0.069	-0.964		
1467.50	125	-074	-063	0.198	0.069	-0.965	83	OC
1468.75	125	-074	-063	0.198	0.069	-0.965		
1470.00	125	-074	-063	0.198	0.068	-0.965	83	OC
1471.25	125	-075	-063	0.198	0.076	-0.965		
1472.50	126	-075	-064	0.198	0.076	-0.965	83	OC
1473.75	126	-075	-064	0.191	0.074	-0.966		
1475.00	126	-075	-064	0.191	0.074	-0.966	83	OC
1476.25	126	-075	-064	0.191	0.074	-0.966		
1477.50	126	-075	-064	0.192	0.073	-0.966	83	OC
1473.75	127	-075	-065	0.192	0.080	-0.966		
1480.00	127	-075	-065	0.184	0.080	-0.967	84	OB
1481.25	127	-075	-065	0.184	0.080	-0.967		
1482.50	127	-075	-065	0.185	0.079	-0.967	84	OB
1483.75	128	-076	-066	0.185	0.079	-0.967		
1485.00	128	-076	-066	0.185	0.079	-0.967	84	OB
1486.25	128	-076	-066	0.185	0.085	-0.967		
1487.50	128	-076	-066	0.178	0.085	-0.967	84	OB
1488.75	129	-076	-067	0.178	0.085	-0.968		
1490.00	129	-076	-067	0.178	0.084	-0.968	84	OB
1491.25	129	-076	-067	0.178	0.084	-0.968		
1492.50	129	-076	-067	0.178	0.084	-0.968	84	OB
1493.75	130	-076	-068	0.171	0.090	-0.969		
1495.00	130	-076	-068	0.171	0.090	-0.969	84	OA
1496.25	130	-077	-068	0.171	0.090	-0.969		
1497.50	130	-077	-068	0.172	0.089	-0.969	84	OA
1498.75	131	-077	-069	0.172	0.089	-0.969		
1500.00	131	-077	-069	0.164	0.089	-0.970	84	OA

A.3 Program Listing - PRINTOUT

```
0100                    ORG 100H
0100 00                         NOP
0101 F3                         DI
0102 31BF37                     LXI SP,0EB0B0
 .. CD2D01                      CALL INZPRNTR
0108 CD5601                     CALL INZDSP
0108 CD7A0B                     CALL CHOICE
010E CD1A0C                     CALL PRNTHDR
0111 CD2E0C                     CALL PRNTINTLN
0114 CD6E01                     CALL INZDSK
0117 CD9E01                     CALL INZVRBLS
011A CD0002                     CALL INZRDATA
011D CD9F05                     CALL INZDRFTW
0120 CD5601                     CALL INZDSP
0123 CD3107                     CALL INZDEMO
0126 C34807                     JMP EJKEY
                        INZPRNTR:
0129 21B27D                     LXI H,7DB2H
012C 3613                       MVI M,13H
012E 21B97D                     LXI H,7DB9H
0131 3612                       MVI M,12H
                        ;SET UP BAUD RATE
0133 3E40                       MVI A,40H
0135 D3F3                       OUT 0F3H
0137 2103D1                     LXI H,0D103H
013A 3536                       MVI M,36H
013C 2100D1                     LXI H,0D100H
013F 3668                       MVI M,68H
 41 3600                        MVI M,0
 43 AF                          XRA A
0144 D313                       OUT 13H
0146 D313                       OUT 13H
0148 D313                       OUT 13H
014A 3E40                       MVI A,40H
014C D313                       OUT 13H
014E 3ECA                       MVI A,0CAH
0150 D313                       OUT 13H
0152 3E37                       MVI A,37H
0154 D313                       OUT 13H
                        INZDSP:
                        ;CLEAR SCREEN, USE 40 CLMNS.,
                        ;USE UPPER AND LOWER CASE
0156 CD00F8                     CALL 0F800H
0159 3E1B                       MVI A,1BH
015B CD03F8                     CALL 0F803H ;40 COLUMNS
015E 3E40                       MVI A,43H
0160 CD03F8                     CALL 0F803H
0163 3E1B                       MVI A,1BH
0166 CD03F8                     CALL 0F803H
0168 3E55                       MVI A,55H
016A CD03F8                     CALL 0F803H
016D C9                         RET
                        INZDSK:
                        ;
                        ;INITIALIZE FILE CONTROL BLOCKS
                        ;AND OPEN ALL FILES
                        ;
016E 210042                     LXI H,FCB01
```

```
0171 3600              MVI M,0
0173 010C00            LXI B,12
0175 1E03              MVI E,3
 73 1616              MVI D,22
                LPM:
017A 09                DAD B
                LPS:
017B 3600              MVI M,0
017D 23                INX H
017E 15                DCR D
017F C27B01            JNZ LPS
0182 1616              MVI D,22
0184 2B                DCX H
0185 1D                DCR E
0186 C27A01            JNZ LPM
0189 0E0F              MVI C,OPEN
018B 110042            LXI D,FCBRD1
018E CD0500            CALL BDOS
0191 112142            LXI D,FCBDRFTM
0194 CD0500            CALL BDOS
0197 114242            LXI D,FCBDEMO
019A CD0500            CALL BDOS
019D C9                RET
                INZVRBLS:
019E AF                XRA A
019F 210000            LXI H,0
01A2 32F841            STA DCCT
01A5 32F441            STA SEQINDX
 A8 22EA41            SHLD YAWR
01AB 22EC41            SHLD PICHR
01AE 22EE41            SHLD ROLLR
01B1 22C441            SHLD YSUM1-2
01B4 22D041            SHLD YSUM2-2
01B7 22C841            SHLD PSUM1-2
01BA 22D441            SHLD PSUM2-2
01BD 22CC41            SHLD RSUM1-2
01C0 22D841            SHLD RSUM2-2
01C3 22C641            SHLD YSUM1
01C6 22D241            SHLD YSUM2
01C9 22CA41            SHLD PSUM1
01CC 22D641            SHLD PSUM2
01CF 22CE41            SHLD RSUM1
01D2 22DA41            SHLD RSUM2
01D5 32DB41            STA YAINC
01D8 32DC41            STA PCINC
01DB 32DF41            STA RLINC
01DE 32F541            STA TOGGL
01E1 21003B            LXI H,3B00H
01E4 22FA41            SHLD SCPTR
01E7 21003C            LXI H,3C00H
01EA 22FC41            SHLD TLMPTR
01ED 21B04A            LXI H,4AB0H
 F0 22FE41            SHLD VSPTR
 F3 210C3C            LXI H,0C00H
01F6 222041            SHLD OPOS
01F9 2140F3            LXI H,0F340H
01FC 222F41            SHLD OINC
01FF C9                RET
```

```
                        INZRDATA:
                        ;
                        ;READ FILE WITH END POINTS
                        ;AND INTERPOLATE TO GET
                        ;1200 PIECES OF DATA EACH FOR
                        ;YAW,PITCH AND ROLL RATES
                        ;
 0200 210036                    LXI  H,3600H
 0203 22E237                    SHLD MOVPTR
 0206 0603                      MVI  B,3
                        SETUPIPS:
 0208 0E14                      MVI  C,READ
 020A 110042                    LXI  D,FCBRD1
 020D CD0500                    CALL BDOS
                        ;
                        ;MOVE 80H BYTES TO INT PTS.STORAGE
                        ;
 0210 2AE237                    LHLD MOVPTR
 0213 118000                    LXI  D,80H
                        MOVLOOP:
 0216 1A                        LDAX D
 0217 77                        MOV  M,A
 0218 13                        INX  D
 0219 23                        INX  H
 021A AF                        XRA  A
 021B BA                        CMP  D
 021C CA1602                    JZ   MOVLOOP
 021F 22E237                    SHLD MOVPTR
 0222 05                        DCR  B
 0223 C20802                    JNZ  SETUPIPS
                        ;
                        ;SET UP TO INTERPOLATE YAW RATE DATA
                        ;
 0226 210036                    LXI  H,BEGYIP
 0229 22EA37                    SHLD STRTPT
 022C 21E04A                    LXI  H,YRDATA
 022F 22E837                    SHLD STRLOC
 0232 CD5402                    CALL LINT
                        ;
                        ;SET UP TO INTERPOLATE PITCH RATE DATA
                        ;
 0235 217A36                    LXI  H,BEGPIP
 0238 22EA37                    SHLD STRTPT
 023B 21E24A                    LXI  H,PRDATA
 023E 22E837                    SHLD STRLOC
 0241 CD5402                    CALL LINT
                        ;
                        ;SET UP TO INTERPOLATE ROLL RATE DATA
                        ;
 0244 21F436                    LXI  H,BEGRIP
 0247 22EA37                    SHLD STRTPT
 024A 21E44A                    LXI  H,RRDATA
 024D 22E837                    SHLD STRLOC
 0250 CD5402                    CALL LINT
 0253 C9                        RET
                        LINT:
                        ;
                        ;F(XI)=[F0X1-F1X0 + (F1-F0)*XI]/[X1-X0]
```

```
                        ;
    0254 210000                 LXI H,0
    0257 39                     DAD SP
     258 22E637                 SHLD LILVSP
    0258 31F637                 LXI SP,LIJUNK
    025E 010000                 LXI B,0000
    0261 110100                 LXI D,1
    0264 C5                     PUSH B
    0265 D5                     PUSH D
    0266 C5                     PUSH B
    0267 2AEA37                 LHLD STRTPT
    026A F9                     SPHL
                    LILOOP:
    026B E1                     POP H    ;F0
    026C 22C137                 SHLD MLTP2
    026F 22F837                 SHLD FZERO       ;FOR LATER
    0272 2AF437                 LHLD XZERO
    0275 3E14                   MVI A,20
    0277 85                     ADD L
    0278 6F                     MOV L,A ;GET X1
    0279 7C                     MOV A,H
    027A CE00                   ACI 0
    027C 67                     MOV H,A
    027D 22C737                 SHLD MLTP1        ;F0 X X1
    0280 210000                 LXI H,0
    0283 39                     DAD SP
    0284 22E637                 SHLD TMPSP
                        ;
                        ;SAVE STACK PTR BEFORE CALL MULT
                        ;
    0287 31CF37                 LXI SP,SCRATCH
    028A CD9603                 CALL MULT
                        ;
                        ;PRODUCT OF MULT = F0 X X1
                        ;
    028D 2AC137                 LHLD ANSL
    0290 22FC37                 SHLD FOX1L
    0293 2AC337                 LHLD ANSM
    0296 22FE37                 SHLD FOX1M
    0299 2AE637                 LHLD TMPSP
    029C F9                     SPHL
    029D E1                     POP H   ;GET F1
    029E 3B                     DCX SP
    029F 3B                     DCX SP  ;=NXT F0
    02A0 22C137                 SHLD MLTP2
    02A3 22FA37                 SHLD FONE
    02A6 2AF437                 LHLD XZERO
    02A9 22C737                 SHLD MLTP1
                        ;
                        ;NEXT X0 = CURRENT X0 + 20
                        ;
    02AC 111400                 LXI D,20
    02AF 19                     DAD D
    02B0 22F437                 SHLD XZERO
    02B3 210000                 LXI H,0
    02B6 39                     DAD SP
    02B7 22E637                 SHLD TMPSP
    02BA 31CF37                 LXI SP,SCRATCH
```

```
  025D CD9803              CALL MULT
                      ;
                      ;PRODUCT FROM MULT = F1 X X0
                      ;
                      ;NOW COMPUTE F0X1 - F1X0
                      ;
  02C0 2AFC37              LHLD F0X1L
  02C3 EB                  XCHG
  02C4 2AFE37              LHLD F0X1M
  02C7 4D                  MOV C,L
  02C8 44                  MOV B,H
                      ;
                      ;BCDE - F0X1
                      ;
  02C9 2AC137              LHLD ANSL
  02CC 7D                  MOV A,L
  02CD 2F                  CMA
  02CE C601                ADI 1
  02D0 6F                  MOV L,A
  02D1 7C                  MOV A,H
  02D2 2F                  CMA
  02D3 CE00                ACI 0
  02D5 67                  MOV H,A
  02D6 22C137              SHLD ANSL
  02D9 2AC337              LHLD ANSM
  02DC 7D                  MOV A,L
  02DD 2F                  CMA
  02DE CE00                ACI 0
  02E0 6F                  MOV L,A
  02E1 7C                  MOV A,H
  02E2 2F                  CMA
  02E3 CE00                ACI 0
  02E5 67                  MOV H,A
  02E6 22C337              SHLD ANSM
                      ;
                      ;ANSM/L = -F1X0
                      ;
  02E9 2AC137              LHLD ANSL
  02EC 19                  DAD D
  02ED 22EC37              SHLD ALST
  02F0 2AC337              LHLD ANSM
  02F3 D2F702              JNC LICN1
  02F6 23                  INX H
              LICN1:
  02F7 09                  DAD B
  02F8 22EE37              SHLD AMST
                      ;
                      ;COMPUTE F1 - F0
                      ;
  02FB 2AF837              LHLD FZERO
  02FE 7D                  MOV A,L
  02FF 2F                  CMA
  0300 4F                  MOV C,A
  0301 7C                  MOV A,H
  0302 2F                  CMA
  0303 47                  MOV B,A
  0304 03                  INX B
  0305 2AFA37              LHLD FONE
```

```
0308 09                    DAD B
0309 224437                SHLD F1XF0
                LISUBLP:
                ;
                ;COMPUTE (F1-F0) X X(I)
                ;
030C 2AE437                LHLD F1XF0
030F 22C737                SHLD MLTP1
0312 2AF237                LHLD IVAL
0315 22C137                SHLD MLTP2
0318 23                    INX H
0319 22F237                SHLD IVAL
031C CD9603                CALL MULT
                ;
                ;COMP. (F0X1-F1X0)+(F1-F0)X X(I)
                ;
031F 2AEC37                LHLD ALST
0322 EB                    XCHG
0323 2AC137                LHLD ANSL
0326 19                    DAD D
0327 22D037                SHLD DVNDL
032A 2AEE37                LHLD AMST
032D EB                    XCHG
032E 2AC337                LHLD ANSM
0331 D23503                JNC LICN2
0334 23                    INX H
                LICN2:
0335 19                    DAD D
0336 22D237                SHLD DVNDM
0339 211400                LXI H,20
033C 22D437                SHLD DVSRL
033F 210000                LXI H,0
0342 22D637                SHLD DVSRM
0345 CD8004                CALL DIVIDE
                ;
                ;QUOT.= (F0X1-F1X0)+(F1-F0)X X(I) / 20
                ;WHERE 20 = X1-X0
                ;
0348 2AD837                LHLD QUOTL
034B EB                    XCHG
                ;
                ;STORE INTERPOLATED DATA POINT
                ;
034C 2AE837                LHLD STRLOC
034F 73                    MOV M,E
0350 23                    INX H
0351 72                    MOV M,D
                ;
                ;INX BY 5 TO STORE NEXT DATA POINT
                ;
0352 110500                LXI D,5
0355 19                    DAD D
0356 22E837                SHLD STRLOC
                ;19 PTS?
0359 3AF037                LDA CTR20
035C 3C                    INR A
035D 32F037                STA CTR20
0360 FE13                  CPI 19
```

```
0362 C20C03              JNZ LISUBLP
0365 AF                  XRA A
0366 32F037              STA CTR20
0369 2AFA37              LHLD FONE
036C EB                  XCHG
036D 2AE837              LHLD STRLOC
                         ;
                         ;STORE F1 AS 20TH POINT
                         ;
0370 73                  MOV M,E
0371 23                  INX H
0372 72                  MOV M,D
0373 110500              LXI D,5
0376 19                  DAD D
0377 22E837              SHLD STRLOC
                         ;
                         ;RESTORE STACK PTR TO GET NEW
                         ;END POINTS
                         ;
037A 2AE637              LHLD TMPSP
037D F9                  SPHL
037E 2AF237              LHLD IVAL
0381 23                  INX H
0382 22F237              SHLD IVAL
                         ;
                         ;HAVE 60X20 PTS BEEN GENERATED?
                         ;
0385 3AF137              LDA CTR60
0388 3C                  INR A
0389 32F137              STA CTR60
038C FE3C                CPI 60
038E C26B02              JNZ LILOOP
0391 2AF637              LHLD LISVSP
0394 F9                  SPHL
0395 C9                  RET
                  MULT:
                         ;
                         ;ZERO OUT MST 1/2 ANS AND CARRY SAVE
                         ;
0396 210000              LXI H,0000
0399 22C337              SHLD ANSM
039C 22C537              SHLD CARYSV
                         ;
                         ;DETERMINE SIGN OF ANSWER
                         ;
039F 2AC737              LHLD MLTP1
03A2 7C                  MOV A,H
03A3 2AC137              LHLD MLTP2
03A6 AC                  XRA H
03A7 32CF37              STA SIGN
03AA 3E80                MVI A,80H
                         ;
                         ;IF MLTP2<0, MLTP2=|MLTP2|
                         ;
03AC A4                  ANA H
03AD FC0004              CM TC16
03B0 CD7303              CALL CHKZERO
03B3 22C137              SHLD MLTP2
```

```
0386 2AC737            LHLD MLTP1
0389 3E80             MVI A,80H
                  ;
                  ;IF MLTP1<0, MLTP1=!MLTP1!
                  ;
03BB A4               ANA H
03BC FC6504           CM TC16
03BF CD7304           CALL CHKZERO
03C2 22C737           SHLD MLTP1
                  ;
                  ;SAVE SP FOR RETURN
                  ;
03C5 210000           LXI H,0
03C8 39               DAD SP
03C9 22C937           SHLD MSVSP
                  ;
                  ;SET UP BIT COUNT
                  ;
03CC 3E11             MVI A,17
03CE 32C037           STA CNT
03D1 31C137           LXI SP,MLTP2
                  MLTLP:
03D4 21FFFF           LXI H,0FFFFH
03D7 39               DAD SP
03D8 35               DCR M
03D9 CA4804           JZ MLPDONE
                  ;
                  ;PUT TEST BIT INTO CARRY
                  ;
03DC F1               POP PSW
03DD D23C04           JNC BIT0
                  BIT1:
03E0 D1               POP D
03E1 C1               POP B
03E2 E1               POP H
                  ;D=MST 1/2 ANS
                  ;B=CARRY SAVE
                  ;H=1ST MULTIPLIER
                  ;
                  ;GET SUM WITHOUT CARRIES
                  ;
03E3 78               MOV A,B
03E4 AA               XRA D
03E5 AC               XRA H
03E6 47               MOV B,A
03E7 79               MOV A,C
03E8 AB               XRA E
03E9 AD               XRA L
03EA 4F               MOV C,A
03EB 21FAFF           LXI H,0FFFAH
03EE 39               DAD SP
03EF F9               SPHL
                  ;
                  ;COMPUTE NEW CARRY SAVE
                  ;
03F0 E1               POP H
03F1 7C               MOV A,H
03F2 E1               POP H
```

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```
      03F3 A4                      ANA H
      03F4 57                      MOV D,A
      03F5 7C                      MOV A,H
      03F6 E1                      POP H
      03F7 A4                      ANA H
      03F8 B2                      ORA D
      03F9 57                      MOV D,A
      03FA 7C                      MOV A,H
      03FB 21FAFF                  LXI H,0FFFAH
      03FE 39                      DAD SP
      03FF F9                      SPHL
      0400 E1                      POP H
      0401 A4                      ANA H
      0402 B2                      ORA D
      0403 57                      MOV D,A
      0404 7D                      MOV A,L
      0405 E1                      POP H
      0406 A5                      ANA L
      0407 5F                      MOV E,A
      0408 7D                      MOV A,L
      0409 E1                      POP H
      040A A5                      ANA L
      040B B3                      ORA E
      040C 5F                      MOV E,A
      040D 7D                      MOV A,L
      040E 21FAFF                  LXI H,0FFFAH
      0411 39                      DAD SP
      0412 F9                      SPHL
      0413 E1                      POP H
      0414 A5                      ANA L
      0415 B3                      ORA E
      0416 5F                      MOV E,A
      0417 E1                      POP H
                        MSTR:
                        ;
                        ;STORE NEW PS(I)
                        ;STORE NEW CS(I)
                        ;
      0418 D5                      PUSH D
      0419 C5                      PUSH B
      041A 3B                      DCX SP
      041B 3B                      DCX SP
      041C D1                      POP D
      041D C1                      POP B
                        ;
                        ;BCDE=PS(I)--MUST BE SHIFTED RIGHT
                        ;BY 1
                        ;
                        SHFT:
      041E AF                      XRA A
      041F 78                      MOV A,B
      0420 1F                      RAR
      0421 47                      MOV B,A
      0422 79                      MOV A,C
      0423 1F                      RAR
      0424 4F                      MOV C,A
      0425 7A                      MOV A,D
      0426 1F                      RAR
```

```
0427 57                    MOV D,A
0428 73                    MOV A,E
0429 1F                    RAR
042A 5F                    MOV E,A
042B C5                    PUSH B
042C D5                    PUSH D
042D C3D403               JMP MLTLP
                  BITO:
                  ;
                  ;COMPUTE PS(I)
                  ;
0430 D1                    POP D
0431 C1                    POP B
0432 78                    MOV A,B
0433 AA                    XRA D
0434 47                    MOV B,A
0435 79                    MOV A,C
0436 AB                    XRA E
0437 4F                    MOV C,A
0438 3B                    DCX SP
0439 3B                    DCX SP
043A 33                    DCX SP
043B 33                    DCX SP
                  ;
                  ;COMPUTE CS(I)
                  ;
043C E1                    POP H
043D 7C                    MOV A,H
 43E 5D                    MOV E,L
043F E1                    POP H
0440 A4                    ANA H
0441 57                    MOV D,A
0442 7B                    MOV A,E
0443 A5                    ANA L
0444 5F                    MOV E,A
0445 C31304               JMP MSTR
                  MLPDONE:
                  ;
                  ;COMPUTE PS(N) + CS(N)
                  ;
0448 33                    INX SP
0449 33                    INX SP
044A E1                    POP H
044B C1                    POP B
044C 09                    DAD B
044D C5                    PUSH B
044E E5                    PUSH H
044F 2AC937               LHLD MSVSP
0452 F9                    SPHL
                  ;
                  ;DETERMINE PROPER SIGN OF PRODUCT
                  ;
0453 3AC537               LDA SIGN
0456 E680               ANI 80H
0458 F0                    RP
0459 2AC337               LHLD ANSH
045C EB                    XCHG
045D 2AC137               LHLD ANSL
```

```
0460 CD0405                CALL TWOSCOMP
0463 22C137                SHLD ANSL
0466 EB                    XCHG
0467 22C337                SHLD ANSM
046A C9                    RET
                    TC16:
                    ;
                    ;SUBROUTINE TO TAKE TWOS COMPLEMENT
                    ;OF 16 BIT WORD HL
                    ;
046B 7D                    MOV A,L
046C 2F                    CMA
046D 6F                    MOV L,A
046E 7C                    MOV A,H
046F 2F                    CMA
0470 67                    MOV H,A
0471 23                    INX H
0472 C9                    RET
                    CHKZERO:
0473 AF                    XRA A
0474 BC                    CMP H
0475 C0                    RNZ
0476 BD                    CMP L
0477 C0                    RNZ
0478 210000                LXI H,0
047B 22C137                SHLD ANSL
047E C1                    POP B
047F C9                    RET
                    DIVIDE:
                    ;
                    ;DIVIDE BY REPEATED SUBTRACTIONS
                    ;THEN ROUND QUOTIENT TO NEAREST
                    ;INTEGER
                    ;
0480 21FFFF                LXI H,0FFFFH
0483 22D837                SHLD QUOTL
0486 22DA37                SHLD QUOTM
                    ;
                    ;DETERMINE SIGN OF QUOTIENT
                    ;
0489 2AD637                LHLD DVSRM
048C 7C                    MOV A,H
048D 2AD237                LHLD DVNDM
0490 AC                    XRA H
0491 32CF37                STA SIGN
                    ;
                    ;IF DVND<0, DVND=|DVND|
                    ;
0494 7C                    MOV A,H
0495 E680                  ANI 80H
0497 F2A904                JP CKDVSR
049A EB                    XCHG
049B 2AD037                LHLD DVNDL
049E CD0405                CALL TWOSCOMP
04A1 22D037                SHLD DVNDL
04A4 EB                    XCHG
04A5 22D237                SHLD DVNDM
                    CKDVSR:
```

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```
                        ;
                        ;IF DVSR<0, DVSR=!DVSR!
                        ;
04A8 2AD637                     LHLD DVSRM
     7C                         MOV A,H
04AC E680                       ANI 80H
04AE F2BF04                     JP DOCKS
04B1 EB                         XCHG
04B2 2AD437                     LHLD DVSRL
04B5 CD0405                     CALL TWOSCOMP
04B8 22D437                     SHLD DVSRL
04BB EB                         XCHG
04BC 22D637                     SHLD DVSRM
                        DOCKS:
                        ;
                        ;IS DVSR 0 OR 1?
                        ;
04BF EB                         XCHG
04C0 2AD437                     LHLD DVSRL
04C3 EB                         XCHG
04C4 AF                         XRA A
04C5 B4                         ORA H
04C6 B5                         ORA L
04C7 B2                         ORA D
04C8 C2D404                     JNZ CKDNO
04CB B3                         ORA E
04CC CA0305                     JZ DIVZERO
04CF FE01                       CPI 1
04D1 CAED04                     JZ DIVONE
                        CKDNO:
                        ;
                        ;IV DVND=0,QUOT = 0
                        ;
04D4 AF                         XRA A
04D5 2AD237                     LHLD DVNDM
04D8 EB                         XCHG
04D9 2AD037                     LHLD DVNDL
04DC B2                         ORA D
04DD B3                         ORA E
04DE B4                         ORA H
04DF B5                         ORA L
04E0 C23605                     JNZ SETUP
                        QUOTO:
04E3 210000                     LXI H,0
04E6 22DA37                     SHLD QUOTM
04E9 22D837                     SHLD QUOTL
04EC C9                         RET
                        DIVONE:
                        ;
                        ;IF DVSR=1,QUOT=DVND
                        ;
04ED 2AD237                     LHLD DVNDM
04F0 EB                         XCHG
04F1 2AD037                     LHLD DVNDL
04F4 3ACF37                     LDA SIGN
04F7 AA                         XRA D
04F8 FC0405                     CM TWOSCOMP
04FB 22D837                     SHLD QUOTL
```

PRNTOUT.PRN

```
04FE EB                      XCHG
04FF 22DA37                  SHLD QUOTM
0502 C9                      RET
                DIVZERO:
0503 76                      HLT
                TWOSCOMP:
                ;
                ;SUBROUTINE TAKES 2'S COMP.
                ;OF 32 BITS IN DEHL
                ;
0504 7D                      MOV A,L
0505 2F                      CMA
0506 C601                    ADI 1
0508 6F                      MOV L,A
0509 7C                      MOV A,H
050A 2F                      CMA
050B CE00                    ACI 0
050D 67                      MOV H,A
050E 7B                      MOV A,E
050F 2F                      CMA
0510 CE00                    ACI 0
0512 5F                      MOV E,A
0513 7A                      MOV A,D
0514 2F                      CMA
0515 CE00                    ACI 0
0517 57                      MOV D,A
0518 C9                      RET
                INCQUOT:
                ;
                ;INCR. QUOT WITH EACH SUCCESSFUL
                ;SUBTRACTION
                ;
0519 2AD837                  LHLD QUOTL
051C 7D                      MOV A,L
051D C601                    ADI 1
051F 6F                      MOV L,A
0520 7C                      MOV A,H
0521 CE00                    ACI 0
0523 67                      MOV H,A
0524 22D837                  SHLD QUOTL
0527 2ADA37                  LHLD QUOTM
052A 7D                      MOV A,L
052B CE00                    ACI 0
052D 6F                      MOV L,A
052E 7C                      MOV A,H
052F CE00                    ACI 0
0531 67                      MOV H,A
0532 22DA37                  SHLD QUOTM
0535 C9                      RET
                SETUP:
                ;
                ;SET DVSR= -DVSR TO DO SUBTRACTION
                ;
0536 2AD637                  LHLD DVSRM
0539 EB                      XCHG
053A 2AD437                  LHLD DVSRL
053D CD0405                  CALL TWOSCOMP
0540 44                      MOV B,H
```

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```
0541  4D                    MOV C,L
                  DIVLP:
0542  CD1905                CALL INCQUOT
0545  2AD037                LHLD DVIDL
0548  22DC37                SHLD REML
054B  09                    DAD B
054C  22D037                SHLD DVIDL
054F  2AD237                LHLD DVNDM
0552  22DE37                SHLD REMM
0555  7D                    MOV A,L
0556  8B                    ADC E
0557  6F                    MOV L,A
0558  7C                    MOV A,H
0559  8A                    ADC D
055A  67                    MOV H,A
055B  22D237                SHLD DVNDM
055E  DA4205                JC DIVLP
0561  2ADC37                LHLD REML
0564  7D                    MOV A,L
0565  17                    RAL
0566  6F                    MOV L,A
0567  7C                    MOV A,H
0568  17                    RAL
0569  67                    MOV H,A
056A  22DC37                SHLD REML
056D  2ADE37                LHLD REMM
0570  7D                    MOV A,L
0571  17                    RAL
0572  6F                    MOV L,A
0573  7C                    MOV A,H
0574  17                    RAL
0575  67                    MOV H,A
0576  22DE37                SHLD REMM
0579  2ADC37                LHLD REML
057C  09                    DAD B
057D  2ADE37                LHLD REMM
0580  7D                    MOV A,L
0581  8B                    ADC E
0582  7C                    MOV A,H
0583  8A                    ADC D
0584  DC1905                CC INCQUOT
0587  3A0F37                LDA SIGN
058A  E680                  ANI 80H
058C  F0                    RP
058D  2ADA37                LHLD QUOTA
0590  EB                    XCHG
0591  2AD837                LHLD QUOTL
0594  CD0405                CALL TWOSCOMP
0597  22D837                SHLD QUOTL
059A  EB                    XCHG
059B  22DA37                SHLD QUOTA
059E  C9                    RET
                  INZDRFTX:
                  ;
                  ;GET INITIAL ALTITUDE AND SPEED
                  ;FROM GNT AND DATA LE
                  ;PARACHUTE DISTRIBUTION TIME
059F  3E17                  MVI A,17H
```

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```
        05A1 112142            LXI D,FCBDRFTM
        05A4 CD0500            CALL BDOS
                        GETALT:
        05A7 110000            LXI D,80H
        05AA 0E09             MVI C,PRINT
        05AC CD0500            CALL BDOS
                        RDALT:
        05AF 0E0A             MVI C,INLINE
        05B1 116041            LXI D,INBUF
        05B4 CD0500            CALL BDOS
        05B7 216141            LXI H,INBUF+1
        05BA 7E               MOV A,M
        05BB FE06             CPI 6
        05BD 4F               MOV C,A
        05BE D22107            JNC AINVENT
        05C1 23               INX H
        05C2 CDB906            CALL ASBCD
        05C5 DA2107            JC AINVENT
        05C8 116141            LXI D,INBUF+1
        05CB 1A               LDAX D
        05CC 13               INX D
        05CD D605             SUI 5
        05CF 0E05             MVI C,5
        05D1 217441            LXI H,INBUF+20
        05D4 CDCA06            CALL PREP
        05D7 217441            LXI H,INBUF+20
        05DA 110000            LXI D,0
        05DD CDE106            CALL TNTHOUS
        05E0 223641            SHLD ALT
        05E3 01AFB9            LXI B,-18001
        05E6 09               DAD B
        05E7 DA2107            JC AINVENT
                        ;GET SPEED
        05EA 0E09             MVI C,PRINT
        05EC 11AE00            LXI D,OAEH
        05EF CD0500            CALL BDOS
                        RDSPEED:
        05F2 116041            LXI D,INBUF
        05F5 0E0A             MVI C,INLINE
        05F7 CD0500            CALL BDOS
        05FA 216141            LXI H,INBUF+1
        05FD 7E               MOV A,M
        05FE FE04             CPI 4
        0600 4F               MOV C,A
        0601 D22907            JNC SINVENT
        0604 23               INX H
        0605 CDB906            CALL ASBCD
        0608 DA2907            JC SINVENT
        060B 116141            LXI D,INBUF+1
        060E 1A               LDAX D
        060F 13               INX D
        0610 D603             SUI 3
        0612 0E03             MVI C,3
        0614 217441            LXI H,INBUF+20
        0617 CDCA06            CALL PREP
        061A 217441            LXI H,INBUF+20
        061D 110000            LXI D,0
        0620 CDF006            CALL HUNDS
```

```
0620  220841              SHLD SPEED
0626  01A7FD              LXI B,-601
0629  09                  DAD B
 62A  DA2907              JC SINVERT
062D  2AB641              LHLD ALT
0630  0160C9              LXI B,-14000
0633  09                  DAD B
0634  DA4206              JC T4PT5
0637  2AB641              LHLD ALT
063A  0190E8              LXI B,-6000
063D  09                  DAD B
063E  D2AB06              JNC T1PT5
0641  2AB841              LHLD SPEED
0644  0110FF              LXI B,-240
0647  09                  DAD B
0648  D2AB06              JNC T1PT5
064B  211600              LXI H,22
064E  22C737              SHLD MLTP1
0651  2AB841              LHLD SPEED
0654  22C137              SHLD MLTP2
0657  CD9603              CALL MULT
065A  2AB841              LHLD SPEED
065D  29                  DAD H   ; 2X S
065E  22D037              SHLD DVNDL
0661  210000              LXI H,0
0664  22D237              SHLD DVNDM
0667  22D637              SHLD DVSRM
 66A  210A00              LXI H,10
066D  22D437              SHLD DVSRL
0670  CD3004              CALL DIVIDE
                   ;QUOT = .2XS
                   ;CALC. 22.2XS
0673  2AD837              LHLD QUOTL
0676  EB                  XCHG
0677  2AC137              LHLD ANSL
067A  19                  DAD D
067B  22C137              SHLD ANSL
067E  2AB841              LHLD SPEED
0681  29                  DAD H
0682  22D037              SHLD DVNDL
0685  210000              LXI H,0
0688  22D237              SHLD DVNDM
068B  22D637              SHLD DVSRM
068E  216400              LXI H,100
0691  22D437              SHLD DVSRL
0694  CD3004              CALL DIVIDE
0697  2AD837              LHLD QUOTL
069A  EB                  XCHG
069B  2AC137              LHLD ANSL
069E  19                  DAD D
                   ;HL = 22.22XSPEED
069F  117384              LXI D,-19333
 6A2  19                  DAD D
06A3  EB                  XCHG
06A4  2AB641              LHLD ALT
06A7  19                  DAD D
06A8  DA4206              JC T4PT5
                   T1PT5:
```

PRNTOUT.PRN

```
06AB 21D802              LXI H,600
06AE 22B441              SHLD PURPTM
06B1 C9                  RET
                T4PTS:
06B2 210807              LXI H,1800
06B5 22B441              SHLD PURPTM
06B8 C9                  RET
                ;CONVERT ASCII-8 BIT BCD
                ASBCD:
06B9 7E                  MOV A,M
06BA FE30                CPI 30H
06BC D8                  RC
06BD FE3A                CPI 3AH
06BF 3F                  CMC
06C0 D8                  RC
                ;OK IF BETWEEN 0,9
06C1 D630                SUI 30H
06C3 77                  MOV M,A
06C4 23                  INX H
06C5 0D                  DCR C
06C6 C2B906              JNZ ASBCD
06C9 C9                  RET
                PREP:
06CA FE00                CPI 0
06CC CAD806              JZ PREP2
06CF 3600                MVI M,0
06D1 23                  INX H
06D2 3C                  INR A
06D3 0D                  DCR C
06D4 C2CA06              JNZ PREP
06D7 C9                  RET
                PREP2:
06D8 1A                  LDAX D
06D9 77                  MOV M,A
06DA 13                  INX D
06DB 23                  INX H
06DC 0D                  DCR C
06DD C2D806              JNZ PREP2
06E0 C9                  RET
                ;
                ;CONVERT 8 BIT BCD TO HEX
                ;
                TNTHOUS:
06E1 7E                  MOV A,M
06E2 23                  INX H
06E3 FE02                CPI 2
06E5 DAEC06              JC TNTCNT
06E8 E1                  POP H
06E9 C32107              JMP AINVENT
                TNTCNT:
06EC FE01                CPI 1
06EE C2F406              JNZ THOUS
06F1 111027              LXI D,10000
                THOUS:
06F4 7E                  MOV A,M
06F5 23                  INX H
06F6 01E803              LXI B,1000
06F9 CD1807              CALL BCDHEX
```

PRNTOUT.PRN

PRNTOUT.PRN

```
05FC E8                        XCHG
                   HNDDS:
05FD 7E                        MOV A,M
05FE 23                        INX H
 6FF 016400                    LXI B,100
0702 CD1807                    CALL BCDHEX
0705 EB                        XCHG
                   TENS:
0706 7E                        MOV A,M
0707 23                        INX H
0708 010A00                    LXI B,10
070B CD1807                    CALL BCDHEX
070E EB                        XCHG
                   UNITS:
070F 7E                        MOV A,M
0710 23                        INX H
0711 010100                    LXI B,1
0714 CD1807                    CALL BCDHEX
0717 C9                        RET
                   BCDHEX:
0718 EB                        XCHG
                   BHLP:
0719 FE00                      CPI 0
071B C8                        RZ
071C 09                        DAD B
071D 3D                        DCR A
071E C31907                    JMP BHLP
                   AINVENT:
                   ;
                   ;INVALID ALTITUDE ENTERED
                   ;
0721 3E04                      MVI A,4
0723 CD03F8                    CALL 0F803H
0726 C3AF05                    JMP RDALT
                   SINVENT:
                   ;
                   ;INVALID SPEED ENTERED
                   ;
0729 3E04                      MVI A,4
072B CD03F8                         CALL 0F803H
072E C3F205                    JMP RDSPEED
                   INZDEMO:
0731 0604                      MVI B,4
                   INZDMLP:
0733 0E14                      MVI C,READ
0735 114242                    LXI D,FCBDEMO
0738 CD0500                    CALL BDOS
073B 0E09                      MVI C,PRINT
073D 118000                    LXI D,80H
0740 CD0500                    CALL BDOS
0743 05                        DCR B
0744 C23307                    JNZ INZDMLP
0747 C9                        RET
                   EJKEY:
0748 0E01                      MVI C,CONIN
074A CD0500                    CALL BDOS
074D FE45                      CPI 'E'
074F CA9907                    JZ EJECT
```

PRNTOUT.PRN

```
0752 3E7F                    MVI A,7FH
0754 CDD3F8                  CALL 0F803H
0757 C34807          .       JMP EJKEY
                     WAITING:
075A 00                      NOP
                     HERE:
075B 00                      NOP ;WAIT FOR INTERRUPT
                     SEQSRT:
075C 2ABA41                  LHLD INTCNTR
075F 23                      INX H
0760 22BA41                  SHLD INTCNTR
0763 228842                  SHLD PREPRINT
0766 318F37                  LXI SP,NEED30
0769 217607                  LXI H,JMPSTRT
076C 3AF441                  LDA SEQINDX
076F 4F                      MOV C,A
0770 0600                    MVI B,0
0772 09                      DAD B
0773 09                      DAD B
0774 09                      DAD B
0775 E9                      PCHL
                     JMPSTRT:
0776 C3A407                  JMP EJCTRTN
0779 C3AC07                  JMP CTPLTRTN
077C C38903                  JMP RKTSEQ
077F C38A0A                  JMP PARSEP
                     EJECT:
0782 318F37                  LXI SP,NEED30
0785 3E04                    MVI A,4
0787 CDD3F8                  CALL 0F803H
078A 3E1B                    MVI A,ESC
078C CDD3F8                  CALL 0F803H
078F 3E3D                    MVI A,'='
0791 CDD3F8                  CALL 0F803H
0794 3E21                    MVI A,21H
0796 CDD3F8                  CALL 0F803H
0799 3E47                    MVI A,47H
079B CDD3F8                  CALL 0F803H
079E 210000                  LXI H,0
07A1 22BA41                  SHLD INTCNTR
                     EJCTRTN:
07A4 0E06                    MVI C,6
07A6 CDB407                  CALL SQUIB
07A9 C3C907                  JMP DRIVER
                     CTPLTRTN:
07AC 0E02                    MVI C,2
07AE CDB407                  CALL SQUIB
07B1 C3C907                  JMP DRIVER
                     SQUIB:
07B4 3E0A                    MVI A,0AH
07B6 CDD3F8                  CALL 0F803H
07B9 3E08                    MVI A,BS
07BB CDD3F8                  CALL 0F803H
07BE 3E2A                    MVI A,LUT
07C0 CDD3F8                  CALL 0F803H
07C3 0D                      DCR C
07C4 C2B407                  JNZ SQUIB
07C7 C9                      RET
```

```
                           SIM:
      07C8  C9                      RET
                           DRIVER:
      77C9  3AF441                  LDA SEQINDX
       7CC  4F                      MOV C,A
      07CD  0500                    MVI B,0
      07CF  21D607                  LXI H,DRVRCK
      07D2  09                      DAD B
      07D3  09                      DAD B
      07D4  09                      DAD B
      07D5  E9                      PCHL
                           DRVRCK:
      07D6  C3DF07                  JMP DRCKA
      07D9  C30808                  JMP DRCKB
      07DC  C33508                  JMP DRCKC
                           DRCKA:
      07DF  2ABA41                  LHLD INTCNTR
      07E2  01F5FF                  LXI B,0FFF5H
      07E5  09                      DAD B
      07E6  DA0008                  JC SSQB
      07E9  3E1B                    MVI A,1BH
      07EB  CD03F8                  CALL 0F803H
      07EE  3E3D                    MVI A,'='
      07F0  CD03F8                  CALL 0F803H
      07F3  3E21                    MVI A,21H
      07F5  CD03F8                  CALL 0F803H
      07F8  3E47                    MVI A,47H
      07FA  CD03F8                  CALL 0F803H
       7FD  C35A07                  JMP WAITING
                           SSQB:
      0800  3E01                    MVI A,1
      0802  32F441                  STA SEQINDX
      0805  C35A07                  JMP WAITING
                           DRCKB:
      0808  2ABA41                  LHLD INTCNTR
      080B  01EBFF                  LXI B,0FFEBH
      080E  09                      DAD B
      080F  DA2908                  JC SSQC
      0812  3E1B                    MVI A,1BH
      0814  CD03F8                  CALL 0F803H
      0817  3E3D                    MVI A,'='
      0819  CD03F8                  CALL 0F803H
      081C  3E27                    MVI A,27H
      081E  CD03F8                  CALL 0F803H
      0821  3E47                    MVI A,47H
      0823  CD03F8                  CALL 0F803H
      0826  C35A07                  JMP WAITING
                           SSQC:
      0829  3E01                    MVI A,1
      082B  323C41                  STA RKTFLG
      082E  3C                      INR A
      082F  32F441                  STA SEQINDX
      0832  C35A07                  JMP WAITING
                           DRCKC:
      0835  3A3C41                  LDA RKTFLG
      0837  FE01                    CPI 1
      0839  CA6808                  JZ ADJCNTR
      083C  CD5D0C                  CALL PRNTLN
```

PRNTOUT.PRN

```
0840 CDB30C              CALL PRNTLN2
0843 3A3642              LDA LINCNTR
0846 3D                  DCR A
0847 3D                  DCR A
0848 323642              STA LINCNTR
084B F25407              JP FIXCONT
084E CDCE0C              CALL TOF
0851 CD1A0C              CALL PRNTHDR
            FIXCONT:
0854 2ABA41              LHLD INTCNTR
0857 01A8FD              LXI B,-600
085A 09                  DAD B
085B DA6103              JC SSQD
085E C35A07              JMP WAITING
            SSQD:
0861 3E03                MVI A,3
0863 32F441              STA SEQINDX
0865 0E01                MVI C,1
0869 CDB407              CALL SQUIB
086B C32A0A              JMP PARSEP
            ADJCNTR:
086E 2ABA41              LHLD INTCNTR
0871 22BD41              SHLD TWNTYFV
0874 210000              LXI H,0
0877 22BA41              SHLD INTCNTR
087A AF                  XRA A
087B 32BC41              STA RKTFLG
087E C35A07              JMP WAITING
            RKFSTM:
0881 0E02                MVI C,2
0883 CDB407              CALL SQUIB
0886 C3C907              JMP DRIVER
            RKTSEQ:
0889 3ABC41              LDA RKTFLG
088C FE01                CPI 1
088E CA8103              JZ RKFSTM
            CKPCEM:
0891 2ABA41              LHLD INTCNTR
0894 110802              LXI D,520
0897 7A                  MOV A,D
0898 BC                  CMP H
0899 C2A303              JNZ INRATDTA
089C 0E01                MVI C,1
089E 7B                  MOV A,E
089F BD                  CMP L
08A0 CCB407              CZ SQUIB
            INRATDTA:
08A3 3E06                MVI A,6
08A5 010000              LXI B,0
08A8 21C341              LXI H,41C3H
08AB 22BC41              SHLD VSPTR
            INLOOP:
08AE 2ABC41              LHLD VSPTR
08B1 09                  DAD B
08B2 03                  INX B
08B3 5E                  MOV E,M
08B4 23                  INX H
08B5 56                  MOV D,M
```

PRNTOUT.PRN

```
08B6 2A8041          LHLD VSTMP
08B9 F9             SPHL
08BA 210200          LXI H,2
08BD 39             DAD SP
08BE 228041          SHLD VSTMP
08C1 2B             DCX H
08C2 2B             DCX H
08C3 09             DAD B
08C4 03             INX B
08C5 F9             SPHL
08C6 E3             XTHL
08C7 19             DAD D
08C8 EB             XCHG
08C9 E3             XTHL
08CA 23             INX H
08CB 23             INX H
08CC 73             MOV M,E
08CD 23             INX H
08CE 72             MOV M,D
08CF 3D             DCR A
08D0 C2AE08          JNZ INLOOP
08D3 2A3241          LHLD VSPTR
08D6 09             DAD B
08D7 223241          SHLD VSPTR
08DA 2AC441          LHLD YSUM1-2
08DD 223A42          SHLD PREPRINT+2
08E0 2AC841          LHLD PSUM1-2
08E3 223C42          SHLD PREPRINT+4
08E6 2ACC41          LHLD RSUM1-2
08E9 223E42          SHLD PREPRINT+6
08EC 2AD041          LHLD YSUM2-2
08EF 229042          SHLD PREPRINT+8
08F2 2AD441          LHLD PSUM2-2
08F5 229242          SHLD PREPRINT+10
08F8 2AD841          LHLD RSUM2-2
08FB 229442          SHLD PREPRINT+12
08FE 318F37          LXI SP,NEED30
            RKTCONT:
0901 CD0A09          CALL UPDAT
0904 CDF809          CALL CNTRLAW
0907 C30907          JMP DRIVER
            UPDAT:
090A 210000          LXI H,0
090D 39             DAD SP
090E 22F641          SHLD SAVE
0911 31C641          LXI SP,YSUM1
            RESID:
0914 D1             POP D
0915 2AEA41          LHLD YAHR
0918 CD3D09          CALL UPLOG
091B 22EA41          SHLD YAHR
091E 32DD41          STA YAINC
0921 D1             POP D
0922 D1             POP D
0923 2AE041          LHLD PTCHR
0926 CD3D09          CALL UPLOG
0929 22E041          SHLD PTCHR
092C 32D841          STA PCINC
```

```
0092F  D1              POP  D
0930  D1               POP  D
0931  2AEB41           LHLD ROLLR
0934  CDBD09           CALL UPLOG
0937  22EB41           SHLD ROLLR
093A  32DF41           STA  RLINC
093D  31E241           LXI  SP,D31
0940  C1               POP  B
0941  E1               POP  H
0942  3ADD41           LDA  YAINC
0945  2F               CMA
0946  3C               INR  A
0947  CDDF09           CALL INDIS
094A  E3               XTHL
094B  3ADE41           LDA  PCINC
094E  CDDF09           CALL INDIS
0951  E3               XTHL
0952  E5               PUSH H
0953  C1               POP  B
0954  E1               POP  H
0955  3ADF41           LDA  RLINC
0958  2F               CMA
0959  3C               INR  A
095A  CDDF09           CALL INDIS
095D  E5               PUSH H
095E  2AE241           LHLD D31
0961  3ADD41           LDA  YAINC
0964  CDDF09           CALL INDIS
0967  C5               PUSH B
0968  E3               XTHL
0969  D1               POP  D
096A  C1               POP  B
096B  3ADF41           LDA  RLINC
096E  CDDF09           CALL INDIS
0971  C5               PUSH B
0972  3B               DCX  SP
0973  3B               DCX  SP
0974  E3               XTHL
0975  3ADE41           LDA  PCINC
0978  2F               CMA
0979  3C               INR  A
097A  CDDF09           CALL INDIS
097D  E5               PUSH H
097E  3AF541           LDA  TOGOL
0981  FE01             CPI  1
0983  D2A209           JNC  UPDON
0986  2AE241           LHLD D31
0989  229642           SHLD PREPRINT+14
098C  2AE441           LHLD D32
098F  229842           SHLD PREPRINT+16
0992  2AE641           LHLD D33
0995  229A42           SHLD PREPRINT+18
0998  3C               INR  A
0999  32F541           STA  TOGOL
099C  31D241           LXI  SP,YSUM2
099F  C31409           JMP  RESID
                UPDON:
09A2  2AE241           LHLD D31
```

PRINTOUT.PRN

```
09A9 22?C42              SHLD PREPRINT+20
09AC 2AE441              LHLD D32
09A8 229E42              SHLD PREPRINT+22
09AE 2AE641              LHLD D33
09B1 22A042              SHLD PREPRINT+24
09B4 AF                  XRA A
09B5 32F541              STA TOGGL
09B8 2AF641              LHLD SAVE
09BB F9                  SPHL
09BC C9                  RET
                UPLOG:
09BD 19                  DAD D
09BE 3E80                MVI A,80H
09C0 A4                  ANA H
09C1 EB                  XCHG
09C2 C2D209              JNZ NEGRS
09C5 2AF241              LHLD QNEG
09C8 19                  DAD D
09C9 3E80                MVI A,80H
09CB A4                  ANA H
09CC 3E01                MVI A,1
09CE C8                  RZ
09CF EB                  XCHG
09D0 AF                  XRA A
09D1 C9                  RET
                NEGRS:
09D2 2AF041              LHLD QPOS
09D5 19                  DAD D
09D6 3E80                MVI A,80H
09D8 A4                  ANA H
09D9 3EFF                MVI A,0FFH
09DB C0                  RNZ
09DC EB                  XCHG
09DD AF                  XRA A
09DE C9                  RET
                INDIS:
09DF FE00                CPI 0
09E1 C8                  RZ
09E2 78                  MOV A,B
09E3 F2E809              JP LABEL
09E6 2F                  CMA
09E7 3C                  INR A
                LABEL:
09E8 5F                  MOV E,A
09E9 E680                ANI 80H
09EB F2F309              JP POSBY
09EE 16FF                MVI D,0FFH
09F0 19                  DAD D
09F1 19                  DAD D
09F2 C9                  RET
                POSBY:
09F3 1600                MVI D,0
09F5 19                  DAD D
09F6 19                  DAD D
09F7 C9                  RET
                CTRLAR:
09F8 3A6711              LDA D33+1
09FB 17                  RAL
```

PRNTOUT.PRN

```
      09FC  DA100A              JC  D33L0
      09FF  3AE341              LDA  D31+1
      0A02  EE7F                XRI  7FH
      0A04  67                  MOV  H,A
                    NEGD2:
      0A05  3AE541              LDA  D32+1
      0A08  2F                  CMA
      0A09  3C                  INR  A
      0A0A  EE7F                XRI  7FH
      0A0C  6F                  MOV  L,A
      0A0D  C3470A              JMP  OUTPUT
                    D33L0:
      0A10  3AE341              LDA  D31+1
      0A13  CD7C0A              CALL  ABS
      0A16  4F                  MOV  C,A
      0A17  5A                  MOV  E,D
      0A18  3AE541              LDA  D32+1
      0A1B  CD7C0A              CALL  ABS
      0A1E  B9                  CMP  C
      0A1F  D2330A              JNC  D32G
      0A22  3E7F                MVI  A,7FH
      0A24  91                  SUB  C
      0A25  4F                  MOV  C,A
      0A26  7B                  MOV  A,E
      0A27  FE80                CPI  80H
      0A29  79                  MOV  A,C
      0A2A  CC370A              CZ  CHS
      0A2D  EE7F                XRI  7FH
      0A2F  67                  MOV  H,A
      0A30  C3050A              JMP  NEGD2
                    D32G:
      0A33  3E7F                MVI  A,7FH
      0A35  90                  SUB  B
      0A36  47                  MOV  B,A
      0A37  7A                  MOV  A,D
      0A38  FE80                CPI  80H
      0A3A  78                  MOV  A,B
      0A3B  C4370A              CNZ  CHS
      0A3E  EE7F                XRI  7FH
      0A40  6F                  MOV  L,A
      0A41  3AE341              LDA  D31+1
      0A44  EE7F                XRI  7FH
      0A46  67                  MOV  H,A
                    OUTPUT:
      0A47  22A242              SHLD  PREPRINT+26
      0A4A  EB                  XCHG
      0A4B  2AFA41              LHLD  SCPTR
      0A4E  73                  MOV  M,E
      0A4F  23                  INX  H
      0A50  72                  MOV  M,D
      0A51  23                  INX  H
      0A52  22FA41              SHLD  SCPTR
      0A55  21E241              LXI  H,D31
      0A58  1600                MVI  D,0
      0A5A  3AF841              LDA  DCCT
      0A5D  5F                  MOV  E,A
      0A5E  19                  DAD  D
      0A5F  3C                  INR  A
```

PRNTOUT.PRN

```
        0A40  3C                      INR A
        0A41  FE05                    CPI 5
        0A63  DA670A                  JC LABEL2
         A65  AF                      XRA A
                        LABEL2:
        0A67  32F841                  STA DCCT
        0A6A  EB                      XCHG
        0A6B  1A                      LDAX D
        0A6C  6F                      MOV L,A
        0A6D  13                      INX D
        0A6E  1A                      LDAX D
        0A6F  67                      MOV H,A
        0A70  EB                      XCHG
        0A71  2AFC41                  LHLD TLMPTR
        0A74  73                      MOV M,E
        0A75  23                      INX H
        0A76  72                      MOV M,D
        0A77  23                      INX H
        0A78  22FC41                  SHLD TLMPTR
        0A7B  C9                      RET
                        ABS:
        0A7C  47                      MOV B,A
        0A7D  3E30                    MVI A,80H
        0A7F  A0                      ANA B
        0A80  57                      MOV D,A
        0A81  78                      MOV A,B
        0A82  F0                      RP
        0A83  2F                      CMA
         A84  3C                      INR A
        0A85  47                      MOV B,A
        0A86  C9                      RET
                        CHS:
        0A87  2F                      CMA
        0A88  3C                      INR A
        0A89  C9                      RET
                        PARSEP:
        0A8A  2A3A41                  LHLD INTCNTR
        0A8D  EB                      XCHG
        0A8E  2A3441                  LHLD PDRFTM
        0A91  7C                      MOV A,H
        0A92  BA                      CMP D
        0A93  C25A07                  JNZ WAITING
        0A96  7D                      MOV A,L
        0A97  BB                      CMP E
        0A98  C25A07                  JNZ WAITING
        0A9B  0E02                    MVI C,2
        0A9D  CD3407                  CALL SQUIB
                        FINISHUP:
        0AA0  318F37                  LXI SP,NEED30
        0AA3  115243                  LXI D,FDISP1
        0AA6  0E09                    MVI C,PRINT
        0AA8  CD0500                  CALL BDOS
        0AAB  215742                  LXI H,FCNT
        0AAE  3631                    MVI M,31H
        0AB0  CD150A                  CALL FIELP
        0AB3  21??41                  LXI H,D31
        0AB6  CD850B                  CALL CNVRTDCS
        0AB9  CD070A                  CALL DISPIT
```

```
        OABC CDE00A                CALL FINLP
        OABF 21E441                LXI H,D32
        OAC2 CD050B                CALL CNVRTDCS
        OAC5 CDD70A                CALL DISPIT
        OAC8 CDE00A                CALL FINLP
        OACB 21E641                LXI H,D33
        OACE CD050B                CALL CNVRTDCS
        OAD1 CDD70A                CALL DISPIT
        OAD4 C30000                JMP 0
                        DISPIT:
        OAD7 0E09                  MVI C,PRINT
        OAD9 114243                LXI D,FDISP
        OADC CD0500                CALL BDOS
        OADF C9                    RET
                        FINLP:
        OAE0 21EF0A                LXI H,ROW+1
        OAE3 34                    INR M
        OAE4 3E1B                  MVI A,ESC
        OAE6 CD03F8                CALL 0F803H
        OAE9 3E3D                  MVI A,'='
        OAEB CD03F8                CALL 0F803H
        OAEE 3E31       ROW:       MVI A,31H
        OAF0 CD03F8                CALL 0F803H
        OAF3 3E37                  MVI A,37H
        OAF5 CD03F8                CALL 0F803H
        OAF8 213742                LXI H,FCNT
        OAFB 7E                    MOV A,M
        OAFC 34                    INR M
        OAFD 214443                LXI H,FDISP+2
        OB00 77                    MOV M,A
        OB01 014843                LXI B,FDISP+6
        OB04 C9                    RET
                        CNVRTDCS:
                        ;COMING IN,HL=ADDRESS OF DC TO BE CONVERTED
                        ;FOR DISPLAY OR PRINT
                        ;BC=STORAGE BUFFER ADD. FOR CONVERTED VALUE
        OB05 5E                    MOV E,M
        OB06 23                    INX H
        OB07 56                    MOV D,M
        OB08 EB                    XCHG
        OB09 3E80                  MVI A,80H
        OB0B A4                    ANA H
        OB0C 3E20                  MVI A,' '
        OB0E F2160B                JP CNVCONT1
        OB11 CD6B04                CALL TC16 ;IF <0,TAKE 2'S COMP
        OB14 3E2D                  MVI A,'-'
                        CNVCONT1:
        OB16 02                    STAX B   ;STORE SIGN OF VALUE (+ OR -)
        OB17 03                    INX B
        OB18 C5                    PUSH B  ;SAVE BEFORE CALL TO MULT AND DIVIDE
                        ;DECIMAL VALUE OF DC = HEX VALUE/4000H
                        ;=> 1000*DEC.VAL=1000*HEX VAL/4000H
                        ;(ELIMINATES NEED FOR FRACTIONAL DIVISION)
        OB19 22C737                SHLD MLTP1
        OB1C 21E803                LXI H,1000
        OB1F 22C137                SHLD MLTP2
        OB22 CD9803                CALL MULT
        OB25 2AC137                LHLD ANSL
```

PRTOUT.PRN

```
0B24 220037          SHLD DVRDL
0B2B 2AC337          LHLD ANSM
0B2E 220237          SHLD DVIDM
0B31 210040          LXI H,4000H
0B34 220437          SHLD DVSRL
0B37 210000          LXI H,0
0B3A 220637          SHLD DVSRM
0B3D CD8004          CALL DIVIDE
0B40 C1              POP B
0B41 3E31            MVI A,'1'
0B43 2AD837          LHLD QUOTL
0B46 1118FC          LXI D,-1000
0B49 19              DAD D
0B4A DA530B          JC CNVCONT2
0B4D 3E30            MVI A,'0'
0B4F 11E803          LXI D,1000
0B52 19              DAD D
             CNVCONT2:
0B53 02              STAX B
0B54 03              INX B
0B55 3E2E            MVI A,'.'
0B57 02              STAX B
0B58 03              INX B
0B59 CD5D0B          CALL HTOA
0B5C C9              RET
             HTOA:
0B5D 119CFF          LXI D,-100
0B60 CD6E0B          CALL GETASC
0B63 11F6FF          LXI D,-10
0B66 CD6E0B          CALL GETASC
0B69 7D              MOV A,L
0B6A C630            ADI 30H
0B6C 02              STAX B
0B6D C9              RET
             GETASC:
0B6E 3E2F            MVI A,2FH
             GETASCLP:
0B70 19              DAD D
0B71 3C              INR A
0B72 DA700B          JC GETASCLP
0B75 02              STAX B
0B76 03              INX B
0B77 EB              XCHG
0B78 CD6804          CALL TC16
0B7B EB              XCHG
0B7C 19              DAD D
0B7D C9              RET
             CHOICE:
0B7E AF              XRA A
0B7F 115F42          LXI D,FCBMENU+12
0B82 214342          LXI H,FCBMENU
0B85 77              MOV M,A
0B86 EB              XCHG
0B87 0615            MVI B,21
             CHLP:
0B89 77              MOV M,A
0B8A 23              INX H
0B8B 05              DCR B
```

PRTOUT.PRN

```
        0B8C C2890B                 JNZ CHLP
        0B8F 0E0F                   MVI C,OPEN
        0B91 CD0500                 CALL BDOS
        0B94 0E14                   MVI C,READ
        0B96 CD0500                 CALL BDOS
        0B99 118000                 LXI D,80H
        0B9C 0E09                   MVI C,PRINT
        0B9E CD0500                 CALL BDOS
                        GETTSTN:
        0BA1 0E01                   MVI C,CONIN
        0BA3 CD0500                 CALL BDOS
        0BA6 320642                 STA FCBRD1+6
        0BA9 FE31                   CPI 31H
        0BAB CABB0B                 JZ TEST1
        0BAE FE32                   CPI 32H
        0BB0 CAC10B                 JZ TEST2
        0BB3 3E04                   MVI A,4
        0BB5 CD03F8                 CALL 0F803H
        0BB8 C3A10B                 JMP GETTSTN
                        TEST1:
        0BBB 112B43                 LXI D,INTLDCS
        0BBE C3C40B                 JMP SETINORIEN
                        TEST2:
        0BC1 113443                 LXI D,INTLDCS+6
                        SETINORIEN:
        0BC4 0E06                   MVI C,6
        0BC6 21E241                 LXI H,D31
        0BC9 CDD30B                 CALL MOVABUF
        0BCC CDDC0B                 CALL SETPRNDCS
        0BCF CDF80B                 CALL SETFDISP1
        0BD2 C9                     RET
                        MOVABUF:
                        ;MOVE 'C' CHARS. FROM 'D' BUFF TO 'H' BUFF
        0BD3 1A                     LDAX D
        0BD4 77                     MOV M,A
        0BD5 13                     INX D
        0BD6 23                     INX H
        0BD7 0D                     DCR C
        0BD8 C2D30B                 JNZ MOVABUF
        0BDB C9                     RET
                        SETPRNDCS:
        0BDC 21E241                 LXI H,D31
        0BDF 01C042                 LXI B,PRNTBUF+28
        0BE2 CD050B                 CALL CNVRTDCS
        0BE5 21E441                 LXI H,D32
        0BE8 01C842                 LXI B,PRNTBUF+36
        0BEB CD050B                 CALL CNVRTDCS
        0BEE 21E641                 LXI H,D33
        0BF1 01D042                 LXI B,PRNTBUF+44
        0BF4 CD050B                 CALL CNVRTDCS
        0BF7 C9                     RET
                        SETFDISP1:
        0BF8 11C042                 LXI D,PRNTBUF+28
        0BFB 213443                 LXI H,FDISP1+50
        0BFE 0E06                   MVI C,6
        0C00 CDD30B                 CALL MOVABUF
        0C03 11C842                 LXI D,PRNTBUF+36
```

```
0C00  219243              LXI  H,FDISP1+64
0C03  0E06                MVI  C,6
0C05  CD3808              CALL MOVABUF
0C08  11D042              LXI  D,PRNTBUF+44
0C11  21A043              lxi  h,fdisp1+78
0C14  0E06                MVI  C,6
0C16  CD3808              call movabuf
0C19  C9                  RET
                  PRNTHDR:
0C1A  21E842              LXI  H,PRHDR
0C1D  3E46                MVI  A,70
0C1F  328542              STA  CHARCNTR
0C22  CD3D0C              CALL PRINTIT
0C25  CDE80D              call tmout
0C28  3E3B                MVI  A,59
0C2A  323642              STA  LNCNTR
0C2D  C9                  RET
                  PRNTINTLN:
0C2E  21A442              LXI  H,PRNTBUF
0C31  3E45                MVI  A,69
0C33  328542              STA  CHARCNTR
0C36  CD3D0C              CALL PRINTIT
0C39  CDE80D              call tmout
0C3C  C9                  RET
                  PRINTIT:
0C3D  0E05                MVI  C,LIST
                  PRNTLP:
0C3F  5E                  MOV  E,M
0C40  23                  INX  H
0C41  CD0500              CALL BDOS
0C44  3A8542              LDA  CHARCNTR
0C47  3D                  DCR  A
0C48  328542              STA  CHARCNTR
0C4B  C23F0C              JNZ  PRNTLP
0C4E  C9                  RET
                  CLRPRBUF:
                  ;ROUTINE TO CLEAR PRINT BUFFER
0C4F  0E41                MVI  C,65
0C51  21A442              LXI  H,PRNTBUF
0C54  3E20                MVI  A,20H
                  PRCLRLP:
0C56  77                  MOV  M,A
0C57  23                  INX  H
0C58  0D                  DCR  C
0C59  C2560C              JNZ  PRCLRLP
0C5C  C9                  RET
                  PRNTLN1:
0C5D  CD4F0C              CALL CLRPRBUF
0C60  3E01                MVI  A,1
0C62  CD720D              CALL INTX2PTS
                  ;GET R(1,25)
0C65  2A3442              LHLD PREPRINT+2
0C68  01AE42              LXI  B,PRNTBUF+10
0C6B  CD330D              CALL CNVRDATA
                  ;GET Q(1,25)
0C6E  2A3642              LHLD PREPRINT+4
0C71  01B442              LXI  B,PRNTBUF+16
0C74  CD330D              CALL CNVRDATA
```

PRNTOUT.PRN

```
                        ;GET P(1.25)
OC77 2A8E42                 LHLD PREPRINT+6
OC7A 01BA42                 LXI B,PRNTBUF+22
OC7D CD330D                 CALL CNVRDATA
                        ;GET D31(1.25)
OC80 219642                 LXI H,PREPRINT+14
OC83 01C042                 LXI B,PRNTBUF+28
OC86 CD050B                 CALL CNVRTDCS
                        ;GET D32(1.25)
OC89 219842                 LXI H,PREPRINT+16
OC8C 01C842                 LXI B,PRNTBUF+36
OC8F CD050B                 CALL CNVRTDCS
                        ;GET D33(1.25)
OC92 219A42                 LXI H,PREPRINT+18
OC95 01D042                 LXI B,PRNTBUF+44
OC98 CD050B                 CALL CNVRTDCS
OC9B 212020                 LXI H,2020H
OC9E 22DB42                 SHLD PRNTBUF+55      ;NO ROLL CMND
OCA1 22E442                 SHLD PRNTBUF+64      ;NO PCH CMND
OCA4 3E45                   MVI A,69
OCA6 328542                 STA CHARCNTR
OCA9 21A442                 LXI H,PRNTBUF
OCAC CD3D0C                 CALL PRINTIT
OCAF CDE80D                 call tmout
OCB2 C9                     RET
                        PRNTLN2:
OCB3 CD4F0C                 CALL CLRPRBUF
OCB6 AF                     XRA A
OCB7 CD720D                 CALL INTX2PT5
                        ;GET R(2.5)
OCBA 2A9042                 LHLD PREPRINT+8
OCBD 01AE42                 LXI B,PRNTBUF+10
OCC0 CD330D                 CALL CNVRDATA
                        ;GET Q(2.5)
OCC3 2A9242                 LHLD PREPRINT+10
OCC6 01B442                 LXI B,PRNTBUF+16
OCC9 CD330D                 CALL CNVRDATA
                        ;GET P(2.5)
OCCC 2A9442                 LHLD PREPRINT+12
OCCF 01BA42                 LXI B,PRNTBUF+22
OCD2 CD330D                 CALL CNVRDATA
                        ;GET D31(2.5)
OCD5 219C42                 LXI H,PREPRINT+20
OCD8 01C042                 LXI B,PRNTBUF+28
OCDB CD050B                 CALL CNVRTDCS
                        ;GET D32(2.5)
OCDE 219E42                 LXI H,PREPRINT+22
OCE1 01C842                 LXI B,PRNTBUF+36
OCE4 CD050B                 CALL CNVRTDCS
                        ;GET D33(2.5)
OCE7 21A042                 LXI H,PREPRINT+24
OCEA 01D042                 LXI B,PRNTBUF+44
OCED CD050B                 CALL CNVRTDCS
                        ;GET ROLL CMND
OCF0 2AA242                 LHLD PREPRINT+26
OCF3 CD1B0D                 CALL GETMST
OCF6 32DB42                 STA PRNTBUF+55
OCF9 CD250D                 CALL GETLST
```

```
    0CFC 320C42              STA PRNTBUF+56
                        ;GET POS CHLD

    00FF 6C                  MOV L,H
        CD1D0D              CALL GETMST
    0D02 326442              STA PRNTBUF+64
    0D06 CD250D             CALL GETLST
    0D09 326542              STA PRNTBUF+65
    0D0C 3E45                MVI A,69
    0D0E 328542              STA CHARCNTR
    0D11 21A442              LXI H,PRNTBUF
    0D14 CD3D0C             CALL PRINTIT
    0D17 CDE80D             call tmout
    0D1A C9                  RET
                        GETMST:
    0D1B 3EF0                MVI A,0F0H
    0D1D A5                  ANA L
    0D1E 1F                  RAR
    0D1F 1F                  RAR
    0D20 1F                  RAR
    0D21 1F                  RAR
    0D22 C3280D             JMP GETCMN
                        GETLST:
    0D25 3E0F                MVI A,0FH
    0D27 A5                  ANA L
                        GETCMN:
    0D28 FE0A                CPI 10
    0D2A DA300D             JC LT10
    0D2D C637                ADI 37H
    0D2F C9                  RET
                        LT10:
    0D30 C630                ADI 30H
    0D32 C9                  RET
                        CNVRDATA:
                        ;HL = VALUE TO BE CONVERTED WHEN CALLED
                        ;BC=BEG ADD. OF STORAGE FOR CNVRTD. VAL
    0D33 3E80            MVI A,80H
    0D35 A4                  ANA H
    0D36 3E20                MVI A,' '
    0D38 F2400D             JP CNVRD1
    0D3B CD5804            CALL TC16
    0D3E 3E20                MVI A,'-'
                        CNVRD1:
    0D40 02                  STAX B
    0D41 03                  INX B
    0D42 C5                  PUSH B
    0D43 220C737           SHLD MLTP1
    0D46 21E803             LXI H,1000
    0D49 22C137             SHLD MLTP2
    0D4C CD9603             CALL MULT
    0D4F 2AC337             LHLD ANSM
    0D52 22D237             SHLD DVNDM
    0D55 2AC137             LHLD ANSL
    0D58 22D037             SHLD DVNDL
    0D5B 21F00F             LXI H,4094
    0D5E 22D437             SHLD DVSRL
    0D61 210000             LXI H,0
    0D64 22D637             SHLD DVSRM
    0D67 CD5304            CALL DIVIDE
```

```
OD6A 2AD837              LHLD OUOTI.
OD6D C1                  POP B
OD6E CD5DOB              CALL HTOA
OD71 C9                  RET
                 INTX2PT5:
OD72 328442              STA X2PT5FLG
OD75 2ABA41              LHLD INTCNTR
OD78 22C737              SHLD MLTP1
OD7B 210A00              LXI H,10
OD7E 22C137              SHLD MLTP2
OD81 CD9603              CALL MULT
OD84 2AC137              LHLD ANSL
OD87 3A8442              LDA X2PT5FLG
OD8A FE01                CPI 1
OD8C CABFOD              JZ SUBT1PT25
                 ANDBITS:
OD8F EB                  XCHG
OD90 3E03                MVI A,3
OD92 A3                  ANA E
OD93 07                  RLC
OD94 213A43              LXI H,TABLE
OD97 85                  ADD L
OD98 6F                  MOV L,A
OD99 D29DOD              JNC CONTINX2
OD9C 24                  INR H
                 CONTINX2:
OD9D 22A1OD              SHLD TBLLBL+1
                 TBLLBL:
ODAO 2A3A43              LHLD TABLE
ODA3 22AA42              SHLD PRNTBUF+6
ODA6 3E2E                MVI A,'.'
ODA8 32A942              STA PRNTBUF+5
ODAB EB                  XCHG
ODAC CDC60D              CALL ROTRGHT
ODAF CDC60D              CALL ROTRGHT
ODB2 1118FC              LXI D,-1000
ODB5 01A542              LXI B,PRNTBUF+1
ODB8 CD6E03              CALL GETASC
ODBB CD5DOB              CALL HTOA
ODBE C9                  RET
                 SUBT1PT25:
ODBF 11FBFF              LXI D,-5
ODC2 19                  DAD D
ODC3 C38FOD              JMP ANDBITS
                 ROTRGHT:
ODC6 AF                  XRA A        ;CLR CARRY
ODC7 7C                  MOV A,H
ODC8 1F                  RAR
ODC9 67                  MOV H,A
ODCA 7D                  MOV A,L
ODCB 1F                  RAR
ODCC 6F                  MOV L,A
ODCD C9                  RET
                 TOF:
ODCE 3E05                MVI A,5
ODDO 328542              STA CHARCNTR
ODD3 1E0A                MVI E,OAH
ODD5 0E05                MVI C,LIST
```

```
                              TOFLP:
     0DD7 CD0500                      CALL BDOS
     0DDA CDE80D                      call tmout
     0DDD 3A8542                      lda charcntr
     0DE0 3D                          dcr a
     0DE1 328542                      sta charcntr
     0DE4 C2D70D                      jnz toflp
     0DE7 C9                          ret
                              tmout:
     0DE8 2100F0                      LXI H,0F000H
                              TMOUTLP:
     0DEB 2D                          DCR L
     0DEC C2EB0D                      JNZ TMOUTLP
     0DEF 25                          DCR H
     0DF0 C2EB0D                      JNZ TMOUTLP
     0DF3 C9                          RET
                              ;INITIALIZE SYS. CALL PRMTRS.
     001C =                   ASSDRV: EQU 28
     0005 =                   BDOS:   EQU 5
     0010 =                   CLOSE:  EQU 16
     0001 =                   CONIN:  EQU 1
     0002 =                   CONOUT: EQU 2
     000B =                   CONRDY: EQU 11
     0013 =                   DELETE: EQU 19
     001F =                   DRVIN:  EQU 31
     0020 =                   DRVOUT: EQU 32
     0021 =                   ERMSG:  EQU 33
     001B =                   GETALO: EQU 27
     0019 =                   GETCUR: EQU 25
     0007 =                   GETIOB: EQU 7
     0022 =                   GETVCB: EQU 34
     000D =                   INIT:   EQU 13
     000A =                   INLINE: EQU 10
     0006 =                   LIST:   EQU 6
     0016 =                   MAKE:   EQU 22
     0023 =                   MOUNT:  EQU 35
     000F =                   OPEN:   EQU 15
     001E =                   PHYDRV: EQU 30
     0009 =                   PRINT:  EQU 9
     0014 =                   READ:   EQU 20
     0017 =                   RENAME: EQU 23
     0011 =                   SEARCH: EQU 17
     000E =                   SELECT: EQU 14
     0012 =                   SERCHN: EQU 18
     001A =                   SETBUF: EQU 26
     0008 =                   SETIOB: EQU 8
     001D =                   UNMONT: EQU 29
     0015 =                   WRITE:  EQU 21
                              ;END SYS.PRMTRS.
     378F =                   NEED30: EQU 378FH
     3600 =                   BEGYIP: EQU 3600H
     367A =                   BEGPIP: EQU 367AH
     36F4 =                   BEGRIP: EQU 36F4H
     4AE0 =                   YIPDATA: EQU 4AE0H
     4A??  =                   PIPDATA: EQU 4A50H
     4A?? =                   RIPDATA: EQU 4A54H
     37?? =                   LIJUNK: EQU 37F6H
     37C? =                   JUNKFLG:         EQU 37C0H
```

PRNTOUT.PRN   PAGE 20

```
C01B =              ESC:     EQU 1BH
0008 =              BS:      EQU 8
C02A =              LGT:     EQU 2AH
37C0                         ORG 37C0H
37C0                CNT:     DS 1
37C1                ANSL:    DS 2
37C1                         ORG 37C1H
37C1                MLTP2:   DS 2
37C3                ANSM:    DS 2
37C5                CARYSV:  DS 2
37C7                MLTP1:   DS 2
37C9                MSVSP:   DS 2
37CF                         ORG 37CFH
37CF                SIGN:    DS 1
37D0                DVNDL:   DS 2
37D2                DVNDM:   DS 2
37D4                DVSRL:   DS 2
37D6                DVSRM:   DS 2
37D8                QUOTL:   DS 2
37DA                QUOTM:   DS 2
37DC                REML:    DS 2
37DE                REMM:    DS 2
37E2                         ORG 37E2H
37E2                MOVPTR:  DS 2
37E4                F1MFO:   DS 2
37E6                TMPSP:   DS 2
37E8                STRLOC:  DS 2
37EA                STRTPT:  DS 2
37EC                ALST:    DS 2
37EE                AMST:    DS 2
37F0                CTR20:   DS 1
37F1                CTR60:   DS 1
37F2                IVAL:    DS 2
37F4                XZERO:   DS 2
37F6                LISVSP:  DS 2
37F8                FZERO:   DS 2
37FA                FONE:    DS 2
37FC                FOX1L:   DS 2
37FE                FOX1M:   DS 2
4160                         ORG 4160H
4160 50             INBUF:   DB 80
4161                         DS 1
4162                         DS 80
41B0                         ORG 41B0H
41B0                VSINP:   DS 2
41B2                VSPTR:   DS 2
41B4                PDRFTM:  DS 2
41B6                ALT:     DS 2
41B8                SPEED:   DS 2
41BA                INTCNTR:         DS 2
41BC                RKTFLG:  DS 1
41BD                TWNTYFV:         DS 2
41C6                         ORG 41C6H
41C6                YSUM1:   DS 2
41CA                         ORG 41CAH
41CA                PSUM1:   DS 2
41CE                         ORG 41CEH
41CE                RSUM1:   DS 2
```

PRNTOUT.PRN

```
42C6 2020                    DB  '  '
42C8                         DS  6
 2CE 2020                    DB  '  '
 2D0                         DS  6
42D6 2020202020             DB  '      '
42DB 2020                    DB  '  '
42DD 2020202020             DB  '      '
42E4 2020                    DB  '  '
42E6 0A0D                    DB  0AH,0DH
              PRHDR:
42E8 2020202054             DB  '     T     '
42F2 2020522020             DB  '   R    Q '
42FC 2020202050             DB  '    P     '
4306 4443312020             DB  'DC1      DC'
4310 3220202020             DB  '2      DC3 '
431A 2020524C2E             DB  '  RL.CMND '
4324 2050432E43             DB  ' PC.CMND'
432C 0A0D                    DB  0AH,0DH
              INTLDCS:
432E 0000                    DB  00,00  ;90 DEG D31
4330 0040                    DB  00,40H ;90 DEG D32
4332 0000                    DB  00,00  ;90 DEG D33
4334 0000                    DB  00,00  ;180 DEG D31
4336 0000                    DB  00,00  ;180 DEG D32
4338 0040                    DB  00,40H ;180 DEG D33
433A 3030        TABLE:      DB  '00'
433C 3235                    DB  '25'
 33E 3530                    DB  '50'
4340 3735                    DB  '75'
4342 444320203DFDISP:        DB  'DC =    .    '
434F 0A0C                    DB  0AH,0CH
4351 24                      DB  '$'
4352 0A0A0D       FDISP1:    DB  0AH,0AH,0DH
4355 494E495449             DB  'INITIAL ORIENTATION'
4368 20202020                DB  '    '
436C 46494E414C             DB  'FINAL ORIENTATION'
437D 0D                      DB  0DH
437E 4443312030             DB  'DC1 =        '
438A 0A0D                    DB  0AH,0DH
438C 4443322030             DB  'DC2 =        '
4398 0A0D                    DB  0AH,0DH
439A 4443332030             DB  'DC3 =        '
43A6 24                      DB  '$'
43A7                         END 100H
```

```
    41D2                        ORG  41D2H
    41D2            YSUM2:  DS  2
    41D6                        ORG  41D6H
     1D6            PSUM2:  DS  2
    .1DA                        ORG  41DAH
    41DA            RSUM2:  DS  2
    41DD                        ORG  41DDH
    41DD            YAINC:  DS  1
    41DE            PCINC:  DS  1
    41DF            RLINC:  DS  1
    41E2                        ORG  41E2H
    41E2            D31:    DS  2
    41E4            D32:    DS  2
    41E6            D33:    DS  2
    41EA                        ORG  41EAH
    41EA            YAWR:   DS  2
    41EC            PICHR:  DS  2
    41EE            ROLLR:  DS  2
    41F0                        ORG  41F0H
    41F0            QPOS:   DS  2
    41F2            QNEG:   DS  2
    41F4            SEQINDX:      DS  1
    41F5            TOGGL:  DS  1
    41F6            SAVE:   DS  2
    41F8            DCCT:   DS  2
    41FA            SCPTR:  DS  2
    41FC            TLMPTR: DS  2
    4200                        ORG  4200H
     200            FCBRD1: DS  1
    4201  5244415441    DB  'RDATA1  DAT'
    420C                        DS  21
    4221            FCBDRFTM:     DS  1
    4222  445246544D    DB  'DRFTMSG TXT'
    422D                        DS  21
    4242            FCBDEMO:      DS  1
    4243  44454D4F44    DB  'DEMODSP TXT'
    424E                        DS  21
                    FCBMENU:
    4263                        DS  1
    4264  4D454E554D    DB  'MENU MSG TXT'
    426F                        DS  21
    4284            X2PTBFLG: DS  1
    4285            CHARCNTR: DS  1
    4286            LNCNTR:  DS  1
    4287            FCNT:    DS  1
                    PREPRINT:
    4288                        DS  28
                    PRNTBUF:
    42A4  20            DB  ' '
    42A5  202020302E    DB  '   0.00'
    42AC  2020          DB  '  '
    42AE  20202030      DB  '    0'
    42B2  2020          DB  '  '
    42B4  20202030      DB  '    0'
    42BC  2020          DB  '  '
    42BA  20202030      DB  '    0'
    42BE  2020          DB  '  '
    42C0                        DS  0
```

APPENDIX B

MULTIPLICATION ALGORITHM

The multiplication algorithm used in the program is based on a method which was actually designed for hardware implementation in digital systems known as the Carry-Save Multiplication. (See DIGITAL SYSTEMS: HARDWARE ORGANIZATION AND DESIGN, Frederick J. Hill and Gerald R. Peterson.)

BASIC DESCRIPTION

The process of multiplying two n-bit binary numbers (to obtain a 2n-bit product) can be viewed basically as forming a 'list' of n numbers (partial products, where each partial product (p_i, i=1, N) is equal to the multiplicand shifted i-1 places to the left if the ith bit of the multiplier is 1; otherwise is equal to 0) to be added together, one at a time, generating n-1 partial sums, the final sum being the product. This process, with n=4, is illustrated in the example in Figure B-1. It is this concept of the multiplication process which provides the basis for the Carry-Save algorithm. There is a difference however in the way in which the partial sums are generated. In the carry-save addition process, each column is considered as essentially independent of the others so that the carry bits are not propagated, but saved as a separate value. This value is then shifted left by 1 and included in the next 'addition'. By this process, n partial sums are generated. The final carry-save value is then added (normal addition) to the nth partial sum to get the product. Figure B-2 illustrates the basic Carry-Save multiplication process on the same problem illustrated in Figure B-1; Figure B-3 illustrates a 'computer form' of this example.

An analysis of this example shows that each partial sum is actually a MOD 2 sum of the 3 values. This can be effected logically by XORing the values, which gives the following equation:

$$PS_{i,i=1,n} = PS_{i-1} \oplus p_i \oplus CS_{i-1}; \ PS_o = 0$$

Though not as obvious, it can be seen that the logic equation for the Carry-Save value generated with PSi is:

$$CS_{i,i=1,n} = (CS_{i-1} \cdot PS_{i-1}) + (CS_{i-1} \cdot pi) + (PS_{i-1} \cdot pi); \ CS_o = 0$$

where · is logical AND, and + is logical OR. Thus, to implement these equations in software then requires only that the machine provide the capability to perform the logic functions XOR, AND, OR.

IMPLEMENTATION

Two parameters (the multiplier and the multiplicand) are passed, in memory locations $37C1_{16}, 37C2_{16}$ and $37C7_{16}, 37C8_{16}$ respectively, when the MULTIPLY subroutine is CALLed. Each of these is a signed (mst bit = SIGN), 16 bit twos complement number. When the multiplication is complete, a signed 32 bit product is returned, in memory locations

-B1-

$$P = PS_3 \left\{ \quad PS_2 \left\{ \quad PS_1 \left\{ \begin{array}{rl} 1011 & \leftarrow \text{ multiplicand} \\ \underline{\times 1101} & \leftarrow \text{ multiplier} \\ \overline{1011} & \leftarrow \\ 0000 & \leftarrow \\ 1011 & \leftarrow \\ \underline{1011} & \leftarrow \\ \overline{10001111} & \leftarrow \end{array} \right. \right. \right.$$

partial products: p_1, p_2, p_3, p_4 — product

$$PS_1 = p_1 + P_2 = \qquad \begin{array}{r} 0000 \quad * \\ 1011 \\ \underline{+0000} \\ \overline{01011} \end{array}$$

$$PS_2 = PS_1 + p_3 = \qquad \begin{array}{r} 01000 \quad * \\ 01011 \\ \underline{+1011} \\ \overline{110111} \end{array}$$

$$P = PS_3 = PS_2 + p_4 = \qquad \begin{array}{r} 1110000 \quad * \\ 110111 \\ \underline{1011} \\ \overline{10001111} \end{array}$$

*The superimposed bits indicate the carry bits generated by the previous column as they propagate through each addition

FIGURE B-1

$$
\begin{array}{r}
1011 \\
\times 1101 \\
\hline
1011 \\
0000 \\
1011 \\
1011 \\
\hline
10001111
\end{array}
$$

0000	← PS_0 (for uniformity)
0000	← CS_0 (for uniformity)
+1011	← p_1
1011	← PS_1
0000	← CS_0
0000	← CS_0 (shifted left by 1)
1011	← PS_1
+0000	← p_2
01011	← PS_2
0000	← CS_2
0000	← CS_2 (left shifted by 1)
01011	← PS_2
+1011	← p_3
100111	← PS_3
0010	← CS_3
0010	← CS_3 (left shifted by 1)
100111	← PS_3
+1011	← p_4
1101111	← PS_4
0010	← CS_4
0010	← CS_4 (left shifted by 1)
1101111	← PS_4
10001111	← Product

FIGURE B-2

Sig.	Reg. Val.	Reg.
PS_0	0000 1101)	AC ML
CS_0	0000)	CS
P_i	1011)	MD·1
PS_1	1011 1101	AC ML
CS_1	0000)	CS
Shift	0101 1110)	AC ML
P_2	0000)	MD·0
PS_2	0101 1110	AC ML
CS_2	0000)	CS
Shift	0010 1111)	AC ML
P_3	1011)	MD·1
PS_3	1001 1111	AC ML
CS_3	0010)	CS
Shift	0100 1111)	AC ML
P_4	1011)	MD·1
PS_4	1101 1111	AC ML
CS_4	0010)	CS
Shift	0110 1111)	AC ML
Add = prod	1000 1111	AC ML

Note: left shift of CS value is accomplished by right shift of PS_i.

FIGURE B-3

$37C1_{16}$ $37C2_{16}$ $37C3_{16}$ $37C4_{16}$ to the CALLing routine.

Before proceeding to multiply the two numbers, the subroutine checks to see if either number is 0; if so, the product is set to 0 and returned to the CALLing routine.

Since, in order to multiply the numbers they must both be positive, the routine now checks the sign of both numbers and determines the sign of the product and sets a flag accordingly; then, the absolute value of each number is used. At the end of the multiplication, the sign flag is checked and the product is set accordingly.

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